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THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
Space Technology Center—Nichols Hall
2291 Irving Hill Drive—Campus West
Lawrence, Kansas 66045



Research on the Application of Satellite Remote Sensing
to Local, State, Regional and National Programs
Involved with Resource Management and Environmental Quality

by

B. G. Barr, Director
Space Technology Center
The University of Kansas

April 1974

An Annual Report of Work Performed
under NASA Grant No. NGL 17-004-024



THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.

2385 Irving Hill Rd.—Campus West Lawrence, Kansas 66044

Acknowledgements

The work reported in this document is the result of the efforts of many people at the University of Kansas Space Technology Center, and various State, county and municipal agencies, as well as NASA and other federal agencies. Acknowledgement of specific individuals and agencies by name is made in project summaries and reports in the Appendix.

B. G. Barr, Principal Investigator
KU/NASA Applications Program

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ABSTRACT

The University of Kansas Space Technology Center has initiated with NASA support a highly successful program designed to involve state, regional and local agency personnel in the application of remote sensing. An integral part of the program is a service-oriented group of individuals with training and experience in all aspects of remote sensing, who can respond quickly to queries from agency personnel. A highly significant accomplishment of the program has been the concurrent development of the rapport necessary to permit easy communication and a viable working relationship with a majority of state agencies in Kansas.

During the period of the grant*, fifteen Applications projects have been initiated in support of twenty-five separate state, county and municipal agencies or entities. Eight of the projects have been completed with positive results which aided the agencies involved. These results included information which contributed to decisions on:

- 1) selection of a route for a scenic parkway
- 2) policy development on open land use
- 3) policy related to urban development
- 4) a major reservoir project by a governor's staff
- 5) control tactics and damage assessment during flooding conditions on the Kansas and Missouri rivers
- 6) initiating a program of habitat inventory by remote sensing by the Kansas Forestry, Fish & Game Commission.

* This annual report covers work completed during the period April 1, 1972 through March 30, 1974 with emphasis on the last twelve months.

THE KANSAS APPLICATIONS PROGRAM

Contacts and Coordination

The KU Applications Program for satellite data is based on a sustained multidisciplinary approach to specific applications projects in state and local agencies carried on at four basic levels (see Figure 1). The first step in the process involved workshops (Level 1) on remote sensing designed to introduce state and local agency personnel to the capabilities of sensors on ERTS-1 and Skylab, and to the latest sensing and interpretation techniques employed by NASA and its several contracting agencies. To date three level 1 workshops have been held at which fifty different agencies were represented by over 125 people. The first workshop was planned for county and area personnel (Douglas County and Kansas City), and held in the KU Space Technology Center in June, 1972. The second was designed to appeal to a broader interest group (Kansas and adjoining states) and included presentations covering geological, agricultural and hydrological applications. The third was held in the western section of the state at the Agricultural Experiment Station, Hays, Kansas, and stressed agricultural and agribusiness interests.

The contacts and associations which developed from these first workshops allowed the program director and coordinator to identify (Level 2) those participants with the authority, competence, and interest necessary to apply satellite and aircraft derived data in their agency. Further discussions were then held with operational personnel to establish action-oriented projects (Level 3) in which Space Technology Center and agency personnel could work cooperatively to obtain and assist in the analysis of remotely sensed data to aid the decision maker.

Periodically and/or as results are obtained from completed or ongoing projects, seminars or conferences are held to convey the findings to other interested agencies (Level 4). A conference of this type was held March 20-30, 1973 under the sponsorship of the Governor's Office of the State of Kansas and the Space Technology Center. This conference was attended by eighty-eight persons representing forty-two different agencies and organizations. Governor Robert Docking keyed the conference, stating in reference to Space Technology and specifically remote sensing: "We must use the expertise and knowledge available so that its potential is realized and brings beneficial results to all Kansans." Presentations by agency participants in demonstration and pilot applications projects funded in whole or in part by the Applications grant constituted the major part of

the program. Twenty-two persons representing ten agencies, divisions or industries met in a workshop session on March 30th to discuss establishment of a remote sensing coordinating group for state agencies through efforts of the Space Technology Center and with the support of the Governor's office. Work is proceeding on this, and it is believed that this can be accomplished early in 1974.

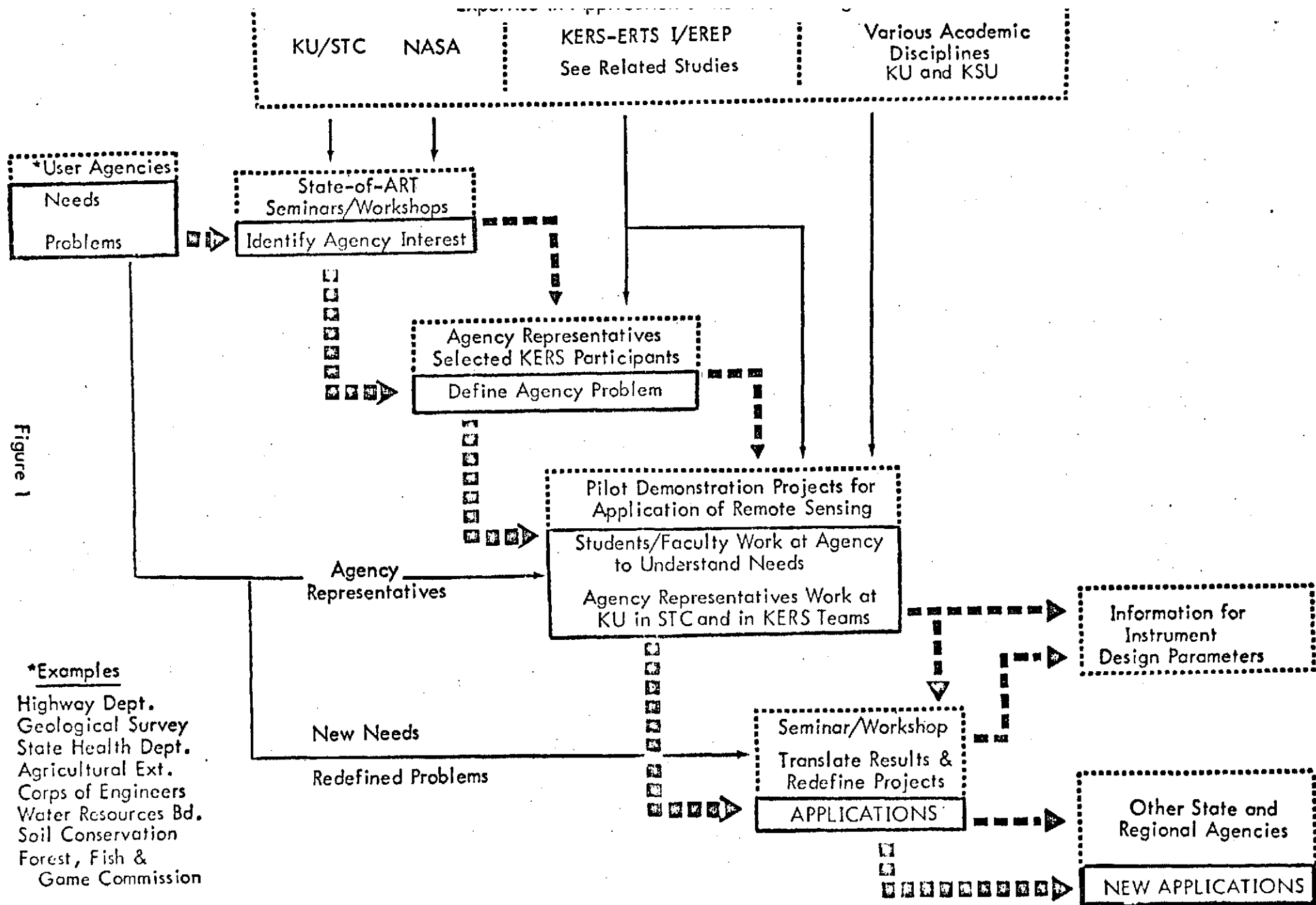


FIGURE 1. KANSAS REMOTE SENSING APPLICATIONS PROGRAM

Responding to Agency Requests

The positive response of state and local agencies during the past eighteen months has demonstrated increasing interest in the program of Application of Satellite Remote Sensing to Resource Management and Environmental Quality. This response from many varied interests suggested that the Kansas Applications Program should include a core group representing certain critical disciplines which could react knowledgeably to specific requests and provide the framework from which a pilot or demonstration project could evolve. It was also apparent that such a core group could respond quickly to specific decision-oriented problems utilizing short term studies. During the current grant year the core group consisted of an engineer, geologist, biologist, geographer, photographer and interpreters. This group, together with agency personnel and additional students and faculty, when required, have been involved in a number of decision oriented projects requiring both quick response and longer term effort. It is our belief, and experience to date corroborates this, that competent helpful response on short term requests by the core group opens the way to longer term projects of more importance later. The short term projects in effect allow communications and some understanding of capability to be established prior to a major commitment of resources or time by either the Applications group or the user agency.

The core group concept is now functioning well and it is believed that it is the most viable approach to the challenging problems encountered in the application of remotely sensed data to real situations. We expect to continue and strengthen this Space Technology Center Applications team as we interact with additional state agencies on new projects.

Coordination with State Officials

Experience gained in the Applications Program thus far points up a need for the Project Director and Coordinator to carry out an aggressive program of repetitive contacts with state agencies. It is not sufficient to hold conferences, publish newsletters, or make occasional calls. A continuing association with key administrators and their staffs is necessary to develop their interest, convince them of the Applications group's knowledge of and access to remotely sensed data and

of its willingness to contribute its expertise to solving the agencies' problems and finally obtain agency commitment of time and resources to a project.

From the outset the K. U. Applications group has attempted to seek active participation of top state officials in the Applications Program. We have been successful in securing this support from the Governor's Office and this support is facilitating the continuing contact with agency heads and business leaders (Attachment A).

Progress in instituting action oriented projects with different state agencies varies considerably from agency to agency. Several have expressed interest, attended seminars, but to date it has not been possible to define with some agencies a project which offered a good probability of success. Nevertheless the contacts and rapport developed with these few agencies have increased and it is believed that projects will result in the near future. In other agencies, projects have evolved rapidly and major cost sharing and personnel commitments have been made to them (Figure II).

During the last quarter we have increased our personal visits to the offices of state agency heads to increase and maintain their awareness of the Application Groups capability and its desire to assist their personnel in the exploitation of the benefits of the aircraft and satellite remote sensing programs. These visits are resulting in much better communication between STC investigators and agency personnel than was possible early in the program. This is occurring primarily because of two factors: 1) previously established knowledge of the KU/NASA Applications Program, and 2) examples of uses to which remotely sensed data has been supplied by other agencies with K. U. assistance.

Need for Continuity

The continued development and successful operation of the K. U. Applications Program is greatly enhanced by the step-funded approach employed. The relationships which are evolving between project personnel and state agencies and in fact between other disciplines at the University and the expertise available at the Space Technology Center would probably not be possible without the long term support of the University Affairs grant. The significant project accomplishments to date have required agency and University resources, however the continuing NASA Applications support has been the crucial element.

Agencies Involved in Applications Projects

Municipal

Kansas City, Kansas

City Planner
Mayor's Office

Lawrence, Kansas

City Commission
Planning Office
City Engineer

County

Douglas

County Planner
County Extension Agent

Cherokee

Board of Commissioners

Republic

Jewell

Mitchell

Cloud

Lincoln

Ottawa

Ellsworth

Saline

RC&D Officials of Four Rivers District
and
Regional Planning Offices

State

Kansas Geological Survey

Governor's Office, Kansas

Kansas Department of Economic Development

Executive Office, Missouri

Missouri Geological Survey

Kansas Forestry, Fish and Game Commission

Office of Civil Defense, Kansas

Department of Agriculture

Water Resources Board

Highway Department, Kansas

Kansas Agricultural Extension Service

Missouri Clear Water Commission

Regional

Ozarks Regional Commission

Federal

U. S. Forest Service

Clark National Forest

U. S. Department of Agriculture

U. S. Army Corps of Engineers Kansas City Office

Soil Conservation Service

Figure II

DATA BASE FOR APPLICATIONS PROGRAM

During the past several years the University of Kansas Space Technology Center has accumulated a large volume of information on remote sensing which will contribute to application studies in progress or being considered.

1. Substantial library of remote sensor imagery including:
 - a. various types of Side-Looking Airborne Radar (SLAR) imagery
 - b. aerial photography largely acquired through NASA Earth Resources aircraft program. Film includes panchromatic black/white, color and color infrared acquired at variety of scale factors. Coverage includes a variety of test sites in and outside of Kansas. It is anticipated that future acquisitions of Earth Resources Program aerial photography will include photography from high altitude aircraft simulating ERTS-1 imagery.
2. Reference material on remote sensing in general, including reports, articles, periodicals, professional journals, symposia proceedings, manuals, textbooks, etc.
3. Specific technical information on remote sensor instrument characteristics and performance.
4. Specific and general information on scientific and technical aspects and objectives of the various spacecraft and aircraft remote sensing programs.

In order to expand the usefulness of the Applications Program, the Space Technology Center has established a data base of ERTS-1 imagery acquired over the State of Kansas, and through the NASA scientific monitors maintains an awareness of the data obtained by ERTS-1 experiments in adjacent states. The data base contains not only imagery, but reference information concerning remote sensing, specific information concerning ERTS-1 imagery such as ground truth availability, etc. These data are made available to user agency representatives participating in the Kansas Applications Program.

FACILITIES

The program director and coordinator and many of the investigators involved in the ERTS-1/EREP investigations have their offices in the K. U. Space Technology Center (STC-Nichols Hall) on the University of Kansas campus. This 70,000 square foot building was designed to house many of the investigators involved in the University's Interdisciplinary Space Research Program, and special attention was given to the establishment of a physical environment and support services which would be conducive to productive interactions between the disciplines. Approximately thirty laboratories and eighty offices are available for faculty and students from Business, Engineering, Social, Biological, Physical and Mathematical Sciences.

A Satellite Applications Laboratory has been established on the second floor of the Space Technology Center as the headquarters of the Applications Program. Light tables, zoom transfer scope, and other equipment needed by the Applications group are being provided by the Space Technology Center to the demonstration projects. In-house Graphic Arts and Photo Services facilities offer complete cartographic and film processing services.

Some STC offices have been set aside for visiting personnel and are used by personnel from state agencies who may need to be housed in close proximity to the working groups during certain periods of their Applications program. Increased chances for use of data by other activities may also occur since approximately 200 faculty members and students from most of the major University departments are housed in the Space Technology Center. Established operational procedures ensure the retention of the normal relationships to home departments while allowing close associations with other disciplines on space-oriented projects. In this way we expect the usefulness and application of results from a given team member to spread more broadly throughout the community of researchers.

The Space Technology Center includes a large, well equipped remote terminal to the University's GE Honeywell 635 computer, as well as an in-house IBM 7094 and smaller PDP 15/20 computer system. These computational facilities are staffed with qualified computer systems specialists. Similarly, a central reports room is staffed to serve the document needs of the occupants in cooperation with the main University library. These facilities provide the investigators with ready access to the University's modern high-speed computer, in-house computational capability, and extensive library resources. The computational facilities are in close proximity to the IDECS which can be used for image interpretations in the Applications Program.

Summary of Results

Since initiation of the Applications Program (April 1972) fifteen projects have been started in support of the activities or interests of twenty-five separate state, county, and municipal agencies or entities. These projects also relate to the interests of five regional and federal agencies.

Eleven of these projects are considered complete, with eight yielding positive results which aided the agency(s) involved. Three of the completed projects terminated without conclusive results or identifiable benefits. Four of the projects are continuing with applications funding and of these, three are receiving significant support from the agencies. Significant cost sharing by the agencies was provided on seven of the fifteen projects. Seven of the completed projects have yielded results or data which we expect to lead to new projects with the same agencies, or reopening of the projects with additional objectives.

Many other projects have been considered, but not initiated due to lack of definition or low probability of success. Four of these are of sufficient interest to remain under consideration pending receipt of additional information or commitment from the agencies involved.

Significant Accomplishments

During the period of the grant the K. U. Space Technology Center Applications Program has:

- (1) Established a core group of specialists in the application of remote sensing who can respond quickly and knowledgeably to queries from local, state and regional agencies concerning the use of satellite and aircraft derived remote sensing data.

- (2) Developed concurrently the rapport with a majority of the state agencies of Kansas necessary to permit easy communication and viable working relationships on a variety of projects. This has been accomplished with the active participation and support of the Governor and his staff (see Attachment A).
- (3) Completed eleven applications projects which provided information important to the following decisions for the agencies shown:
 - a. Douglas County-Lawrence Planning Commission — Clinton Reservoir project (Figure III).
 1. Selection of a route for a major scenic parkway through the area based on land use and earth form information.
 2. Selection of land for urban development (by delimiting that which had a low potential for wildlife development).
 3. A significant input into the policy decision concerning open land use — particularly related to forestry and dense wooded areas which are relatively scarce in eastern Kansas.

The data provided by the K. U. Applications Program was in the words of the Douglas County - Lawrence Planner, "the significant data on which the planning decisions were made for the area surrounding the reservoir and it was beyond the capability of our staff (city-county planning office) to obtain the required data in the time frame available and with our resources."

- b. Executive Office, State of Missouri — Pattonsburg Dam Project, Grand River Basin.

1. Provided data on land use in the proposed reservoir area and in the area to be protected downstream from the site to the confluence of the Grand and the Missouri Rivers. The Executive Office was particularly concerned with the impact of the permanent loss of quality agricultural land on the food supply and agricultural production in Missouri. The data supplied by the Applications Program specifically addressed this question. Multi-spectral aircraft photographs and ERTS images were employed in this study which is expected to continue (see letters dated December 4 and 28, 1973, Attachment C).

- c. Kansas City, Kansas — Mayor's Office, Civil Defense Office.

1. Provided rapid response and interpretive support during a major flood threat on the Missouri and Kansas rivers. A letter from Mayor Richard Walsh dated October 19, 1973 indicated that Applications group "contributions had great utility both during

Clinton Reservoir Policy and Action Decisions*
Lawrence Douglas County Planning Commission

<u>MAP NAME</u>	<u>KU/NASA Applications Grant Contribution</u>
Base Map	Location and Shape of Ponds Description of Roads Surfaces
Land Use	Location of Structures Description of Different Land Uses Configuration of Land of Different Classes of Land Use
Existing Vegetation	Description, Location and Configuration of Different Type of Vegetation
Utilities	Location of Some Utility Lines
Wildlife Habitat	The Whole Study was Provided by the K. U. Applications Group
Scenic Value	Location of Rocks Formation and Potential Outlooks (Determined by Studying the Interpretation of Topography, Forests & the Future Lake)
Guide Plan	K. U. Applications Group Information Helped to Propose <ol style="list-style-type: none"> 1. Location of Urban Areas 2. " " Open Spaces 3. " " Scenic Route 4. " " Lake-Oriented Development

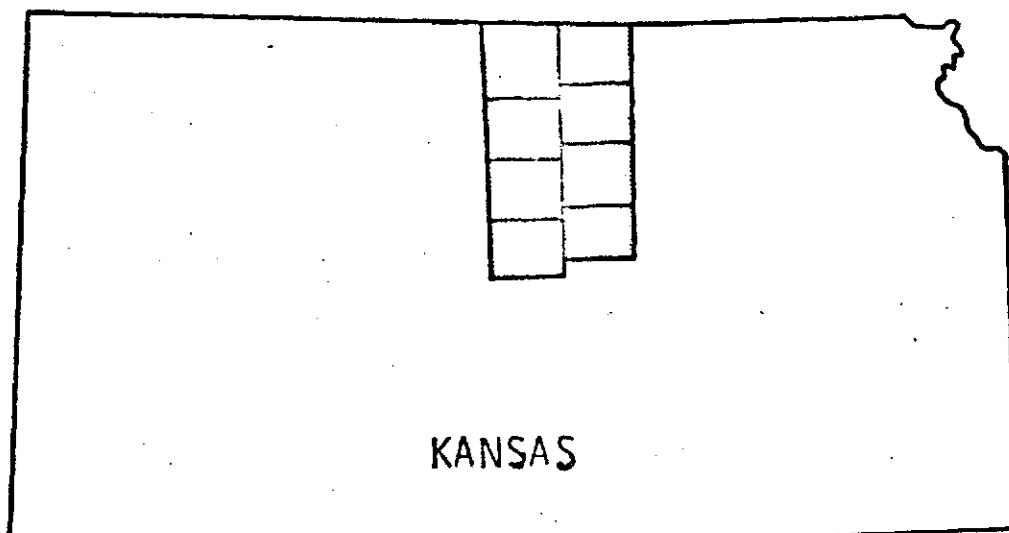
1. Land with high potential for wildlife habitat; dense woods, cropland, land with high scenic value become negative factors for urban type of development- conversely, existing concentration of non-rural buildings favors urbanization proposals.
2. Dense woods and rock formation (among other factors not provided by KU/STC) aid to determine the location of open spaces proposed as conservation areas.
3. Location of outlooks and rock formation were factors included to design and designate both the scenic route and lake-oriented cells.

Supplied by: Martha Munczek, Lawrence
Douglas County Planning Office
— December, 1973

*Also see letter from R. A. McClanathan, Director of Planning, dated 9/7/73
(Attachment B).

the immediate emergency situation and in damage assessment activities after the water receded" (Attachment D).

- d. Kansas Forestry, Fish and Game Commission — assess the utility of high altitude and ERTS imagery as a means to inventory the wildlife habitat of Kansas and relate this to the management decisions of the agency.
 - 1. A habitat biologist with training in remote sensing has been employed by the Commission to devote full time to this project. This man, Bruce Waddell, works closely with Applications personnel at the University of Kansas Space Technology Center two to three days each week on the project. The remainder of his time is devoted to field work and introducing other FF&G personnel to project goals and results.
 - 2. Completed mapping of the habitats in the Jefferson County test site. Major progress made on tabulation of acreage of various habitat types and calculations of interspersions are complete for approximately half of the test area.
- e. U. S. Army Corps of Engineers — Clinton Reservoir, Douglas County.
 - 1. Determine the feasibility of utilizing multi-band, multi-date imagery for revelation of vegetation, geology, soil type, surface drainage patterns, and measurement of structural units. Project considered a success by K. U. Principal Investigator and Corps personnel in that their staff became knowledgeable concerning the capabilities of multi-band photography. Funding of the project provided primarily (70%) by the Corps. Further studies of the Clinton Dam site using multispectral photography is anticipated after impoundment of water.
- f. Four Rivers Resource, Conservation and Development District (eight counties — North Central Kansas). Eight County citizen groups (total 64 persons) and U. S. Department of Agriculture — Soil Conservation Service (Figure IV).
 - 1. Provided land-use and other informational maps to committees planning development of the district.
 - 2. It is expected that land use maps will be used in providing input to routing of new section of I-35, development of new industry and development of prime agricultural land.
- g. Kansas City, Kansas/ Wyandotte County planner — develop land-use map for Kansas River Flood Plain.
 - 1. Interpreters from K. U. Applications group trained personnel



Four Rivers Resource Conservation and Development Project

Parties Involved: Jewell, Republic, Mitchell, Cloud, Lincoln, Ottawa, Ellsworth and Saline counties and Soil Conservation Service USDA Salina, Kansas.

Source of Land-Use Maps: Earth Resources Technology Satellite, flights of October 26, 1972, April 6, 1973 and June 7, 1973. Bands 5 and 7.

Map Sources: USDA Soil Conservation Service
 Kansas State Geological Survey
 University of Kansas Space Technology Center

Atlas of Maps:	Geology	Pipeline (Oil and Gas)
	Availability of Ground Water	Soils
	Gas and Oil Fields	Irrigation
	Water Body	Land-Use

Maps Derived from ERTS-I: Land-Use and Water Body

Figure IV

in the Planner's Office in the use of remotely acquired data for land use planning of Armourdale District. A deadline for decisions set by the Board of Commissioners made it impossible to obtain information in conventional way (ground survey and census data). Applications Group provided aerial coverage in various spectral bands. Kansas City, Kansas Planning Department personnel accomplished interpretations under guidance of K. U. Applications personnel.

h. Kansas Mineral Resources Institute and Geological Survey —

Evaluate effectiveness of reclaiming strip mined land.

1. Completed feasibility study of remote sensing to evaluate progress of reclamation of land strip mined for coal in S.E. Kansas. Preliminary cost effective analysis indicates potential savings of 35% over conventional methods of monitoring compliance with reclamation directives.

i. Kansas City District, U. S. Army Corps of Engineers — Evaluation of soil moisture conditions related to outflow from Rathbun Dam.

1. Provided rapid response multispectral flights and interpretation to evaluate soil moisture conditions and vegetation effects in the Chariton River flood plain. Applications personnel participated in helicopter ground truth checks on conditions in a thirty mile long by 2-3 mile wide area from Centerville, Iowa to Worthington, Missouri.

This project was funded primarily by the Corps, and is the first phase in an experimental project to manage outflow releases from a reservoir as related to farming practices in the area.

Governor's Conference on Application of Remote Sensing — Governor's Office and Space Technology Center.

A very successful conference on the Application of Space Technology to Resource Management and Environmental Quality was held on March 29 and 30, 1973. This conference keynoted personally by the Governor was attended by eighty-eight persons representing all of the major state agencies of Kansas, several local and regional agencies, industry, and several agencies from adjacent states. This seminar covered the applications projects from the point of view of the agency participant (manager, scientist, or engineer). The response to the conference was enthusiastic, based on a tabulation of an evaluation form used to measure its effectiveness.

j. Douglas County Applications of Remote Sensing - DCARS -
Douglas County Officials.

This project is designed to provide a current source of multiband photographic information that can be applied to any public project/use requiring remote sensing data in Douglas County. Proximity to K. U., character of terrain and expected land use changes in the most rapidly growing discrete community in Kansas dictated selection of this area.

Several projects have evolved from the data thus far:

Clinton Reservoir Land Use Mapping; Geological Investigations - U. S. Army Corps of Engineers @ Clinton Dam Site; assessment of agricultural land capability; updating of land use information for publication of the Douglas County Soil Survey; Interpretation of road surface materials for county engineer; and use by City Engineer to restore land fill area to near original conditions.

Due to the demonstrated use of the site we plan to take periodic multiband photographs to update the data bank. This data will be used in the immediate future by the Douglas County Planner and the Douglas County Assessor. Minimal expense is required due to county size and proximity for flight operations.

Summaries and reports on the projects listed above are included in the Appendix to provide more detailed information on objectives, approach and status.

It is difficult in many cases to establish when a project is complete, due to the interactive relationships which are being established, and training (of agency and Applications group personnel), which is being accomplished during the program. Although we classify projects as "complete", we fully expect the contacts established while working on these projects to continue to develop and the data acquired during the projects to be useful in initiation of the next phase or next project with these or other agencies. Experience to date shows that the Applications group personnel are becoming more proficient in all aspects of the applications of remote sensing data to the requirements of the agencies they contact. Discussions with agency representatives now involve fewer generalities. The definition of project objectives and the establishment of the responsibilities of the various personnel involved is arrived at much quicker and stated more precisely. We expect this sharpened focus to manifest itself in more significant objectives and results as the program continues.

The K. U. Space Technology Center investigators (Remote Sensing Laboratory and Applications Group personnel) continue to have available an aerial platform suitable for various sensors (up to 15,000 ft. altitude). This capability has become well known in the region, due to the Applications seminars and word of mouth advertising based on successful completion of projects in support of numerous agencies. As a result, the Applications group is frequently asked to fly missions with our aircraft, sensors and operator, in support of others involved in remote sensing activities in the region. During the current grant year this support is being provided for five different groups on a cost reimbursable basis at no cost to the Applications Program. These related activities reduce the unit cost of operating the aircraft for K. U. Applications projects, and also serve to introduce others to multispectral images and data from other sensors (radar, magnetometer, etc.).

ATTACHMENTS

STATE OF KANSAS



Attachment A

OFFICE OF THE GOVERNOR
State Capitol
Topeka

ROBERT B. DOCKING
Governor

November 8, 1973

Mr. B. G. Barr, Director
The University of Kansas
Space Technology Center
2291 Irving Hill Drive - Campus West
Lawrence, Kansas 66044


Dear Bill:

Pat Burnau showed me your recent note and the enclosed copy of your letter to Chancellor Dykes reviewing your success in assisting state and local governments with the services available at the University of Kansas Space Technology Center.

I am pleased our office has been of assistance to you. Your program has proved to be beneficial to many state agencies. Thank you for your help. Please never hesitate to contact me at any time.

With every good wish.

Yours sincerely,


Robert Docking
Governor of Kansas

RD/jj

cc: Chancellor Archie Dykes
University of Kansas
Lawrence, Kansas 66044

CHAIRMAN
WILLIAM J. WOMACK

VICE-CHAIRMAN
MICHAEL J. DAVIS

COMMISSIONERS
E. J. ALLISON
HOMER C. ALTENBERND
JANE T. COMBEST
CLARENCE GORDON
ALVIN D. HAVERTY
ROLAND W. HURST
JOHANNA KOLLMORGEN
DWAYNE W. PEASLEE

LAWRENCE - DOUGLAS COUNTY

Attachment B

PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4800
EXTENSION 36

910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

September 7, 1973

Mr. Bill G. Barr, Executive Director
Center for Research, Inc.
West Campus, Kansas University
Lawrence, Kansas 66045

Dear Mr. Barr:

Thank you for the contribution of the University of Kansas Center for Research, Inc., in the development of the Clinton Reservoir Area Mini-Comprehensive Plan.

The information gathered by the CRINC staff, through interpretations of aerial photographs and field surveys, included data on existing native vegetation and agriculture; earth forms; potential for wildlife habitats; and existing land use.

The Lawrence-Douglas County planning staff utilized this information to complement, and compared with, other factors compiled by our office. For instance, soil capability information provided by the Soil Conservation Service and present agricultural use areas, as compiled by the CRINC staff, were checked for correlation. The land use information allowed us to update existing base data on transportation routes and type of road surfacing; utility service systems; quarries; surface water; and residential, commercial, and industrial properties. The earth forms data assisted in locating areas having possible scenic value. Data showing areas having a high degree for potential wildlife habitat was compared with and utilized as argumentative reinforcement for the preservation of dense wood stands, marshlands, and unique topographical areas.

Finally, the information compiled and analyzed by both the CRINC and local planning staffs served as the data basis from which Mr. Ronald Jones, Planning Consultant, developed the proposed Clinton Reservoir Area Mini-Comprehensive Plan.

Mr. Bill G. Barr, Executive Director
Lawrence, Kansas 66045
September 7, 1973
Page 2

We would also like to emphasize that CRINC's contributions have led on to a better understanding and evaluation of many social, political, and economic factors in addition to developing an approach to physical land use planning.

We again thank you for making this program available to us and are sincerely hopeful collaboration between CRINC and the Lawrence-Douglas County planning staff will again be possible in the future.

Yours truly,

A handwritten signature in dark ink, appearing to read "Richard A. McClanathan", with a long horizontal flourish extending to the right.

Richard A. McClanathan
Lawrence-Douglas County
Director of Planning

RAM/ed

EXECUTIVE OFFICE
STATE OF MISSOURI
JEFFERSON CITY

CHRISTOPHER S. BOND
GOVERNOR

May 10, 1973

Dr. William Barr, Director
The University of Kansas Center
for Research, Inc.
2291 Irving Hill Road - Campus West
Lawrence, Kansas 66044

Dear Bill:

On behalf of all of us who were able to meet with you, Bob Walters and Bob Eastmond, may I offer our sincere thanks. I am very hopeful that better utilization by our state agencies, and increased inter-agency cooperation will result from the meeting.

We would like to ask you whether you could supply us with some information on the Grand River in Missouri. Enclosed please find two maps to help determine the area to be studied.

The data we need will be concerned with the proposed Pattonsburg Dam project, to determine existing land use patterns both in the areas which would be inundated and the new areas below the dam which would become more useful. If we are supplied with ERTS or high-altitude or middle-altitude imagery, we would, of course, need your help in interpreting the data to determine land use in the areas. We would also be able to utilize your data on the lands covered by the recent flooding to determine those areas to be protected by the project.

The information would be for Governor Bond to assist him in his independent review of the proposed Pattonsburg Dam project. The information would be utilized by the Governor's Council on Water Resource Planning which he has established to assist in this decision-making process.

Dr. William Barr
May 10, 1973
Page 2

Since the Council must have all of its information together in order to provide the Governor with its recommendation by July 31, it hopes to have accumulated all of its research material by the end of June. In this case, however, we could utilize information provided by you closer to the July 31 deadline.

We would appreciate knowing whether you would be able to work with us on this tight time schedule. Once again, thank you for your kind assistance. We look forward to a close and beneficial working relationship with you.

Sincerely yours,

A handwritten signature in cursive script, reading "Marvin J. Nodiff". The signature is written in dark ink and is positioned above the printed name and title.

Marvin J. Nodiff
Program Assistant

MJN:cw

Enclosures

EXECUTIVE OFFICE
STATE OF MISSOURI
JEFFERSON CITY
December 4, 1973

CHRISTOPHER S. BOND
GOVERNOR

Dr. Bill G. Barr, Executive Director
The University of Kansas Center for
Research, Inc.
Lawrence, Kansas 66044

Dear Bill:

This is to advise you of the state's progress on our review efforts on the proposed Pattonsburg Dam project, Grand River Basin.

Our initial review of the project this past summer indicated that there were several significant questions surrounding the feasibility and effects of the project. Among these was the impact of the permanent loss of quality agricultural land, and the effect of this on food supply and agricultural production in Missouri. The data you gathered through the NASA applications program and reported to us, particularly in regard to land use patterns, was very helpful in our study effort.

Presently we are engaged in a joint state-federal restudy of the proposed project, including the U.S. Army Corps of Engineers, the Soil Conservation Service and several state agencies. The deadline for this effort is December 1974. In this regard, we look forward to receiving the aerial mosaic indicating land use patterns and categories which you have been working on to finalize your participation in our study. As further guidelines on the restudy effort are developed we will certainly keep the University of Kansas Space Technology Center in mind for future work.

Dr. Bill G. Barr
December 4, 1973
Page 2

Your continuing concern and assistance in these matters are sincerely appreciated.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Marvin".

Marvin J. Nodiff
Program Assistant

MJN:cw

EXECUTIVE OFFICE
STATE OF MISSOURI
JEFFERSON CITY

CHRISTOPHER S. BOND
GOVERNOR

December 28, 1973

Dr. Bill G. Barr, Director
The University of Kansas Space Technology
Center
2291 Irving Hill Dr.--Campus West
Lawrence, Kansas 66044

Dear Bill:

This will acknowledge recent of the land use maps
of the Pattonsburg site prepared by Bob Eastman.

Thank you for the very fine assistance in this
project, and I am sure these maps will be very useful
to us in the future.

Sincerely yours,



Marvin J. Nodiff
Program Assistant

MJN:cw



CITY OF KANSAS CITY, KANSAS
EXECUTIVE CHAMBER

October 19, 1973

RICHARD F. WALSH, MAYOR

Chancellor Archie Dykes
University of Kansas
Strong Hall
Lawrence, Kansas 66044

Dear Chancellor:

Last week our city was faced with flooding problems of a magnitude not equalled since 1951. This time we had a new addition to our emergency crew, an aerial photography team from the Space Technology Center at the University of Kansas.

This team, which I understand is part of the N.A.S.A. Applications Program under the direction of B.G. Barr, covered the full spectrum from aircraft and camera to support from expert photo interpreters, and gave us a new dimension in our civil defense efforts. Their contribution had great utility both during the immediate emergency situation and in damage assessment activities after the water receded.

This letter is to acknowledge the role played by this aerial photography team and to express our gratitude for their help. It is a credit to the State of Kansas and the University that such facilities can be made available to aid local governments in times of need. I hope that services like this can be continued in the future both with our city and with other cities throughout the State.

As effective as this support was, there is much to be gained from institutionalizing or formalizing the linkages between the University and local/state disaster efforts. By doing this, we could work together to effectively integrate this unfamiliar technology into future disaster relief efforts. Image interpretation support is as vital in this regard as rapid delivery of images.

I would again like to express deep thanks to the University, and to the staff of the Space Technology Center for rapid and professional aid during our community's time of need.

Very truly yours,

Richard F. Walsh
Mayor

cc: B. G. Barr
University of Kansas

APPENDIX

Summaries and technical reports prepared on Kansas Applications projects.

<u>Summary Designation</u>	<u>Project Title</u>
(a)	Clinton Reservoir Land-Use Mapping Using Multispectral Aerial Photography and ERTS-1 Imagery
(b)	Pattonsburg Lake Land Use Assessment
(c)	Flood Threat Interpretation in Support of Kansas City, Kansas
(d)	Using Remote Sensing for a Wildlife Habitat Inventory of Kansas
(e)	Remote Sensing Study of Clinton Reservoir and Clinton Dam Site
(f)	A Regional Land Use Map for the Four Rivers Resource Conservation Development Project
(g)	Develop a Land Use Map Using Remote Sensing in the Kansas River Floodplain, Wyandotte County, Kansas
(h)	The Use of Remote Sensing to Evaluate Reclamation of Land Strip-Mined for Coal
(i)	Evaluation of Soil Moisture Conditions Related to Release Outflow from Rathbun Dam
(j)	Douglas County Applications of Remote Sensing

APPLICATIONS PROJECT SUMMARY

Project Title: Clinton Reservoir Land-Use Mapping Using Multispectral Aerial Photography and ERTS-1 Satellite Imagery

Participating Agencies: Lawrence-Douglas County Planner

Key Personnel:

Agency: 843-4600

Dick McClanathan, Planner

Martha Munczek

CRINC:

Robert Eastmond, Professor of Botany

John Barr, Research Assistant

B.G. Barr, Project Director

Robert Walters, Coordinator

Tentative Completion Date: 15 March 1973

Starting Date: 5 February 1973

1.0 Introduction:

The Clinton Reservoir, presently being constructed by the U. S. Army Corps of Engineers, is located southwest of Lawrence, Kansas. When completed the multipurpose reservoir will have a surface area of 7,000 acres all in Douglas County. At full capacity the surface area would be 12,000 acres and would extend into eastern Osage County. It is expected that such a lake will have some impact on the land use in the surrounding area. To plan and control land use changes will require background on the present conditions and detailed information concerning present and potential land uses.

2.0 Statement of Work

2.1 Objectives:

In response to a request from the Lawrence Douglas County Planner, the Kansas Applications program has undertaken this project to assist in the development of a series of map overlays describing specific land use characteristics required for future planning decisions.

Land use data from available 70mm aerial photography and ERTS-A imagery will be compared to determine the utility and cost/benefits of each in such land use mapping.

2.2 Approach:

The Lawrence-Douglas County Planning staff will utilize conventional data sources to obtain information on flood prone areas, soils, slopes, historic sites, utilities, and scenic and land values.

Applications staff will utilize 70mm aerial photography (Color IR, Multi-band B & W) to compile data on surface water, mineral resources, vegetation, agriculture, wildlife habitat, transportation routes, earth forms and residential and commercial land use. Level 2 land use data from the ERTS data will be compared with the above.

2.3 Anticipated Results

It is anticipated that the Douglas County Planning Commission will take action on the results of this study by developing the planning and zoning policies in connection with development in the Clinton Reservoir area. Future planning decisions can then be made on the basis of the present conditions and potentials of the area involved. Updating of base data may be accomplished using satellite imagery or selected aerial photography.

2.4 Funding:

Funded by Applications Grant; cost sharing by Lawrence - Douglas County Planning Commission.

APPLICATION OF REMOTE SENSING
TO LAND USE CLASSIFICATION SURROUNDING
CLINTON RESERVOIR, DOUGLAS COUNTY, KANSAS

Robert J. Eastmond
John C. Barr

in cooperation with the
Lawrence-Douglas County Planning Department

Technical Report 2230-8
May 1973

Partially Supported by NASA Grant NGL 17-004-024



THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
2385 Irving Hill Rd.—West Campus Lawrence, Kansas 66044

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The Clinton Reservoir, presently being constructed by the U.S. Army Corps of Engineers southwest of Lawrence, Kansas, will have considerable impact on the land use in the surrounding area. The multipurpose pool will have a surface area of 7,000 acres all in Douglas County. Temporary storage at full capacity (flood pool) will cover 12,000 acres of Wakarusa River Valley. At flood pool the water would extend about 4 miles into Osage County. (Figures 1 and 2)

Clinton Lake was authorized by Congress in 1962 as a unit of the Kansas River and Missouri River Comprehensive Plans for flood control and water development. In 1965, the State of Kansas included Clinton Lake in the State Water Plan Act for multipurpose use including flood control, municipal and industrial water supply, streamflow regulation, recreation and fish and wildlife enhancement. To plan and control such multiple use changes requires background information on the present conditions and detailed data concerning the present and potential land uses.

In response to a request from the Lawrence-Douglas County Planner, the Kansas Applications Program developed this project to assist in describing specific existing land use characteristics required for future planning decisions. The Lawrence-Douglas County Planning Staff will utilize conventional data sources to obtain information on flood prone areas, soils, slopes, historic sites, utilities, and land values, etc. The Applications staff has utilized remote sensing technology to compile data on surface water, mineral resources (quarries), agricultural and natural vegetation, wildlife habitat, transportation routes (roads), earth forms, and residential/commercial land use.

Photography and Interpretation

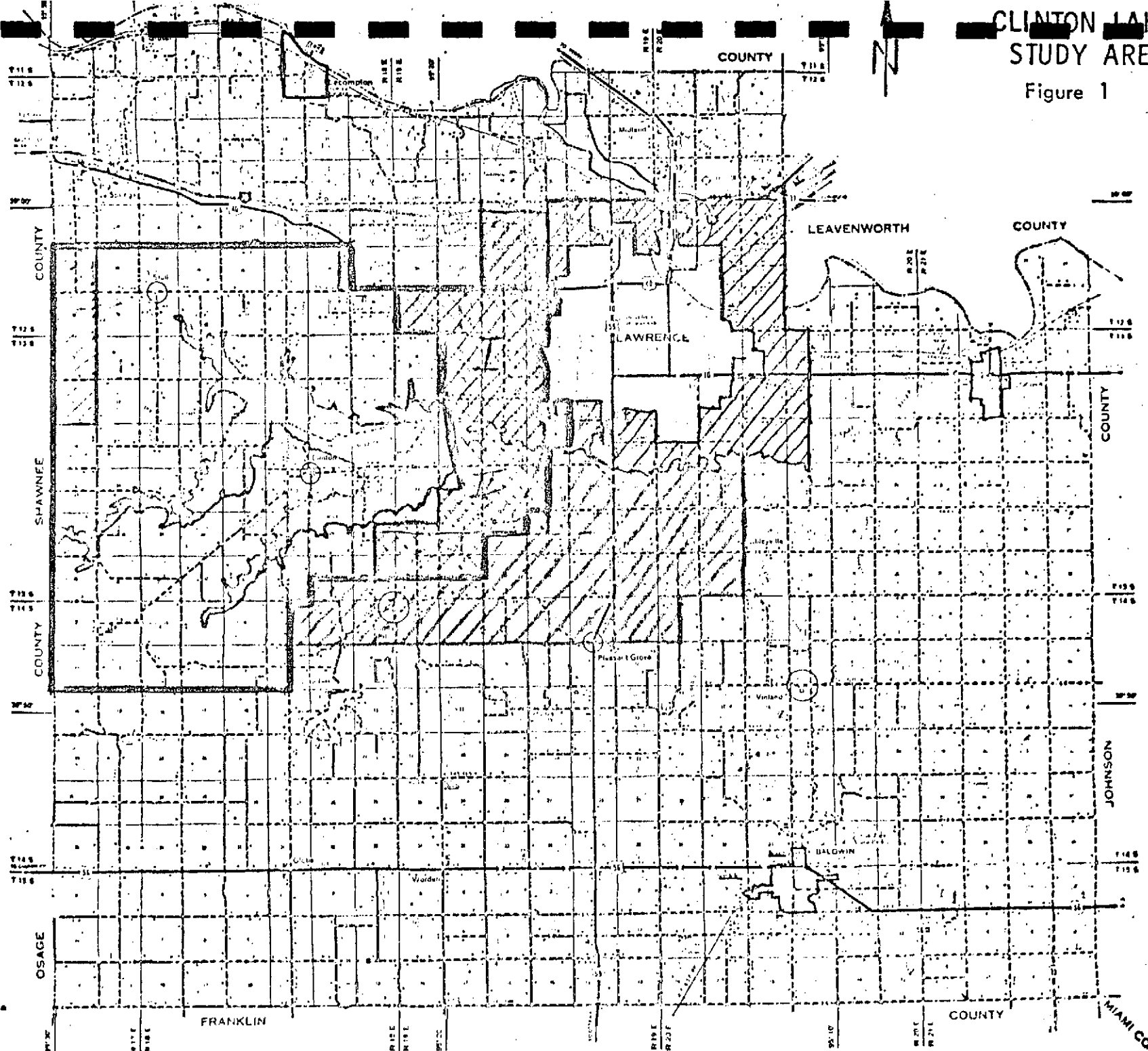
The imagery used for the land use interpretation was flown by CRINC with a Cessna 182 aircraft on July 7, 1972. Both color infrared and multiband photography were taken. The multiband imagery included green, red and near infrared black & white bands. The original scale of the photography is approximately 1:80,000. The interpretation was done utilizing the original films and prints of the red band at two different scales, one set at approximately 1:24,000 and the other at approximately 1:16,400. Most often the land use data was taken from the 1:24,000 prints. But for each classification category, there was generally a combination of scales and bands needed for interpretation. Considerable supplemental data including ground truth information was used in the interpretation process.

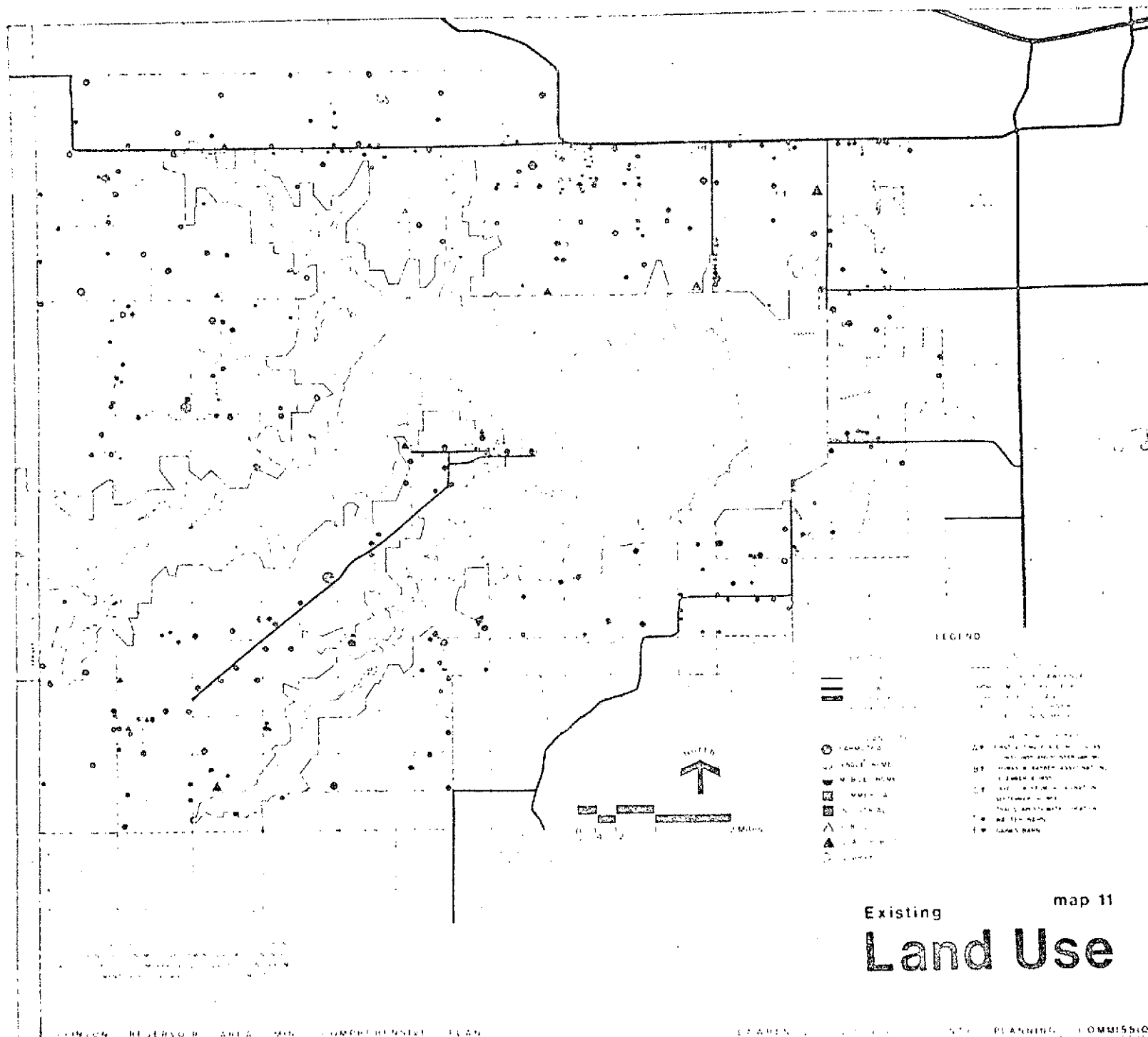
Definitions and Descriptions of Categories

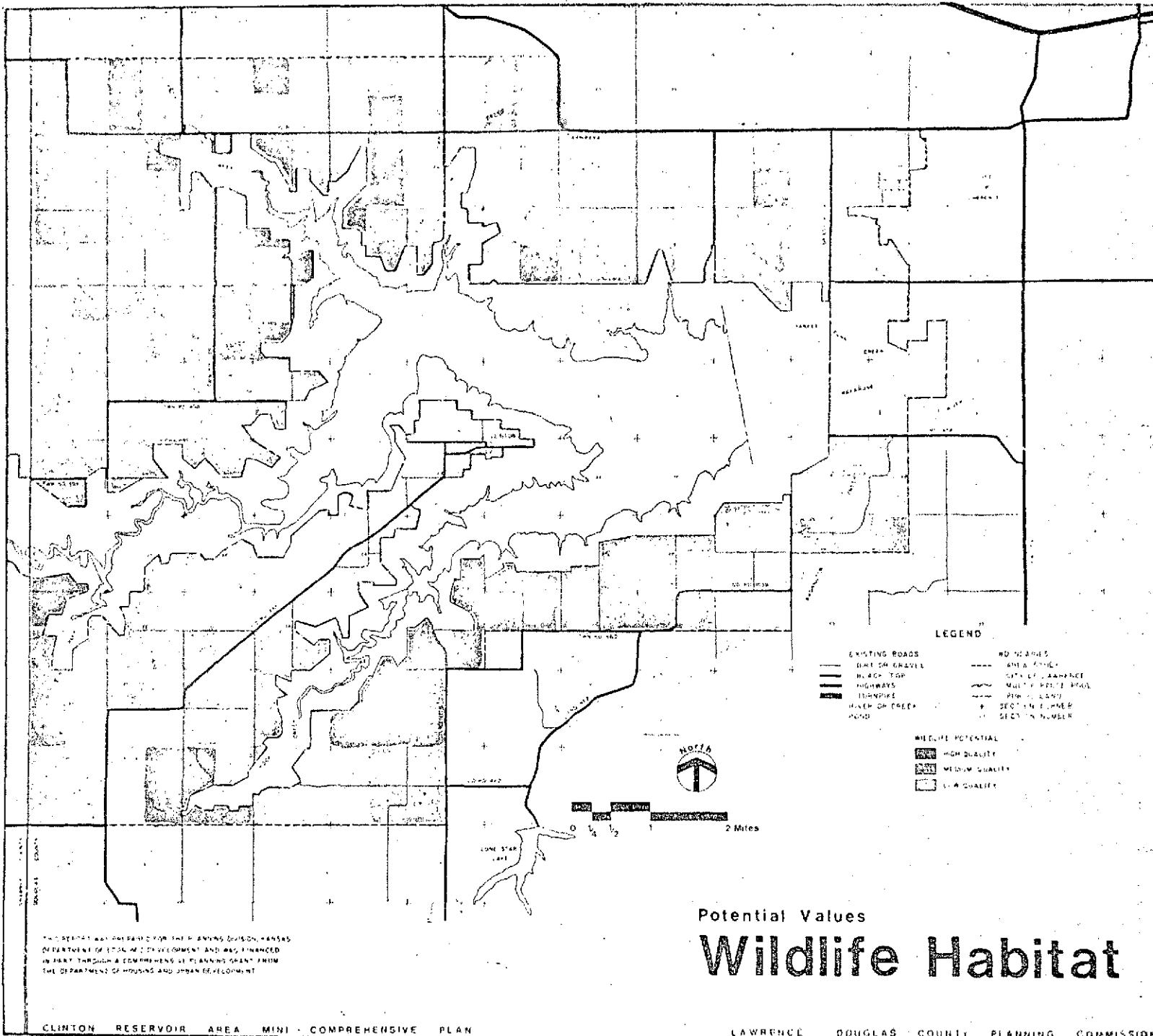
The land use categories were defined in terms of tone, shape, and pattern on the photographs. The interpretation was then cross referenced with available supplemental data prior to construction of the overlays. A detailed description of each of the seven

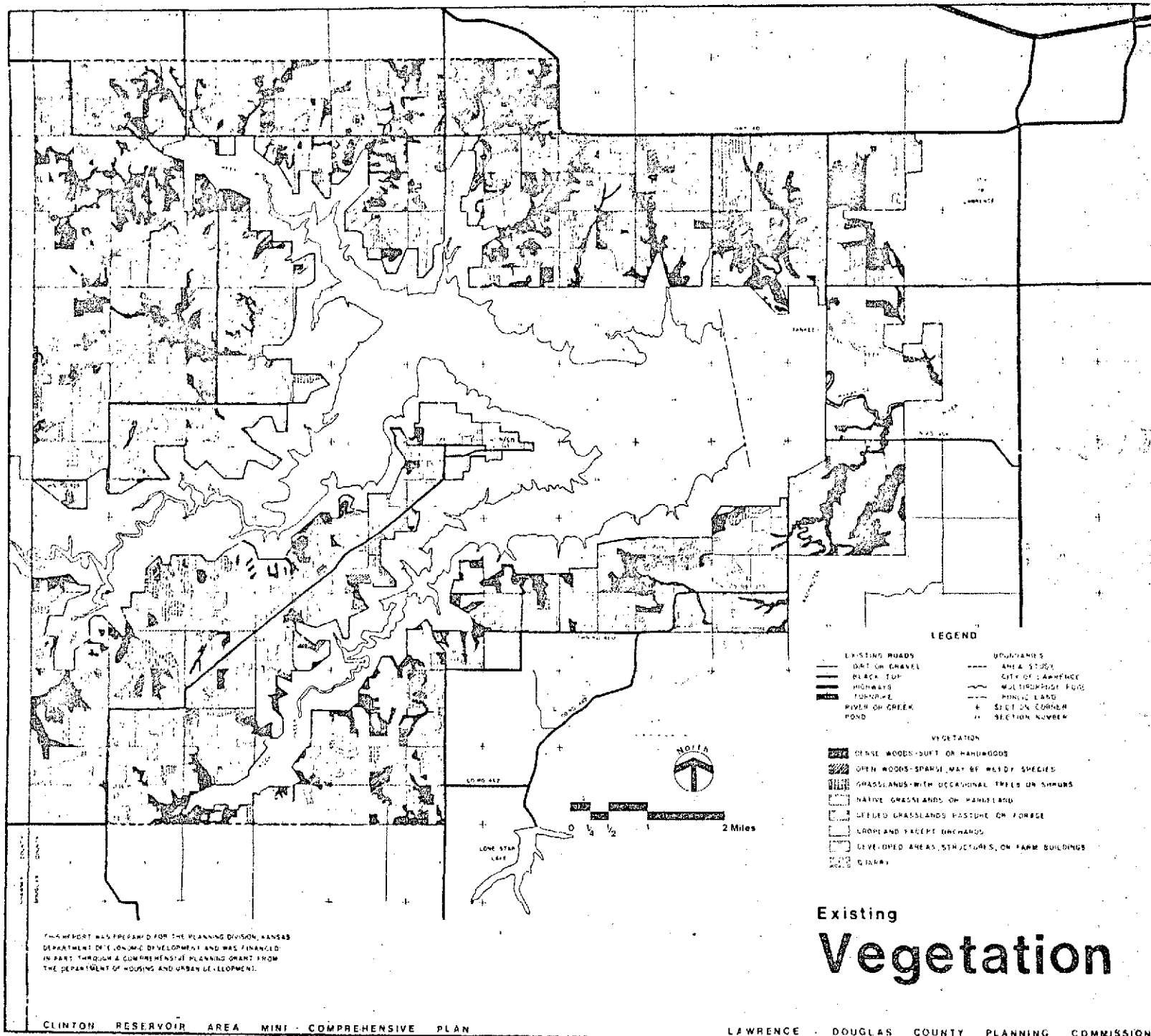
CLINTON LAKE
STUDY AREA

Figure 1









Existing Vegetation

land use categories follows including: surface water, mineral resources (quarries), transportation routes (roads), residential/commercial land use, earth forms, agricultural and natural vegetation, and wildlife habitat potential.

Surface Water

Smooth, still water normally appears fairly dark in color on black and white photographs. Sediment in the water tends to reflect light, therefore, on the photograph such water appears grey to white in tone. On the black and white infrared photographs water stands out very dark (black) in tone and is easily identified. Ponds and lakes were identified on both the color and black & white infrared films. The water bodies identified were then located on the 1:24,000 red band prints to enable areal mapping onto the topographic sheets.

Extractive Mineral Resources

Quarries were mapped on the topographic sheets and thus only needed confirmation of existence or updating where new quarries existed. The extractive quarry (limestone or sand and gravel) land use was identified on the basis of road networks and disturbed vegetation patterns. Shadow is an index to the depth of pits and quarries. Generally active sand pits or quarries appear much lighter than the surrounding ground cover.

Transportation Routes (Roads)

Roads are very prominent on aerial photographs, and details of the road net are quite apparent. They appear as narrow bands of light lines.

Hard surface roads of concrete or asphalt are clear-cut in outline with emphasis on uniform width, easy curves, and smooth surface. Improved gravel or dirt roads usually appear wider and lighter than paved roads. Unimproved roads are of irregular width. Usually they are narrow and follow a more erratic course than improved roads.

Road surfaces in the study area were either asphalt, gravel or dirt. The topographic maps were very accurate as to the extent and location of the road network. A map obtained from the Douglas County Engineer was used to check both the extent and location of the network and also as a check on the interpretation of the type of road surface. A set of green band prints (scale approximately 1:16,400, July 7, 1972) from another project was found to be the best imagery for interpretation of the road surfaces.

Residential/Commercial Land Use

Residential

Residential types for most classifications could be distinguished on the 1:24,000 scale, red band prints. Where classification as to type was difficult, the larger scale

prints were used to provide a larger "image". When more detail was required, the original film was used under a microscope that was capable of 3X magnification. This same method to obtain scale and resolution advantage when necessary was used for all categories.

Farm Homes

Farm homes were identified generally on the presence near the structure of barns or other out-buildings. Also used as indicators were roads or stock paths to fields adjacent to the structures. The category delimited on the map as farm homes included all of the area occupied by the home, those out-buildings very near the home and open spaces or yards directly associated with these structures. Two farms of commercial stature were identified.

Out-Buildings

This classification was given to isolated structures that did not fit any of the previously mentioned categories. Generally they were either associated with a farm or were abandoned structures.

In several instances, a question mark (?) was placed on the land use map. This indicates a lack of "sureness" with the classification assigned. Where no classification was made and a question mark exists, two situations are possible.

1. A structure was mapped (by the Geological Survey) on the topographic sheet but was not observable in the imagery.
2. A structure existed in the imagery for which its category of land use was not known.

Mobile Homes

Mobile homes were generally classified on the basis of there length to width ratio. Increasing use of "double-wide" mobile homes may have caused the incorrect identification of some mobile homes as regular single family dwellings. Driveway pattern was also used to separate the mobile from single family homes. For single family homes, and especially those with garages, the driveway is generally perpendicular to the house itself. For a mobile home, the driveway would generally either end at a point not adjacent to the structure or would be a semi-circle drive, tangent to the structure.

Single Family Home

Essentially the single family home classification was the process of elimination of the other two categories. The presence of dual driveways, porches or patios could serve to indicate multiple-family dwellings, but no dwellings of this type were identified within the study area. Obviously some multiple-family dwellings do exist within the boundaries of Lecompton and Clinton but this distinction was not needed for the land

use map. In some instances, structures that fit the criteria for single family homes were in fact farm homes. These structures could be identified as farm homes by observation of other large isolated structures in the area that were barns or other out-buildings and were connected by minor road networks. Such a classification is by necessity very subjective.

Commercial and Industrial

No industrial classifications were made in the area. Only one commercial classification was made and this was by both elimination and the presence of what appeared to be space allocated as a parking lot. In addition, two farms were classified as "commercial farms" because of their obvious complexity.

Public

Public land areas generally were schools and park areas. Most of these uses were already identified on the topographic maps that were used as the base for the land use map. Generally such uses could be identified by their size, spatial context and associated surrogates such as recreational facilities.

Semi-public

Semi-public uses consisted of such categories as churches and cemeteries. Again, many of these uses were already on the topographic sheets. Because of the scale of the imagery used for interpretation, the topographic maps were heavily relied upon for semi-public land uses such as churches. Cemeteries could easily be identified because of their areal extent and their road and vegetation patterns.

The 1:24,000 red band prints were used as the mapping base for all interpretations. Transparent plastic was overlayed on the prints to delimit the areal extent and spatial allocation of the land uses. These transparencies were the overlayed on the topographic sheets and the land use data transferred to the maps.

In addition, a map indicating the general spatial distribution of structures for which building permits had been issued was used to cross-check the interpretation. This was helpful where the exact use of a structure (that appeared on both maps) was difficult to identify. But, the map also contained some errors and did not accurately locate the structures.

Agricultural and Natural Vegetation

Agricultural and natural vegetation were classified into the following general categories: dense woods, open woods, grassland with scattered trees, native grassland, tame grassland and pasture, and cropland.

The woodlands of eastern Kansas are difficult to classify into composition classes due to their high variability. This variation results from factors such as human occupation and treatment, aspect involving slope and exposure, soils, and moisture. Commonly upland forest species include Elm, Ash, Hickory, Oaks, Hackberry, and Locust as well as numerous others. Riparian forests commonly consist of Sycamore, Cottonwood, Box Elder and several Willows. For the purposes of this study and considering the data base (aerial photography) and the time limitations, an ecological or species composition classification was not attempted. Rather, forested areas were classified as to the density of tree cover. Some inferences may be made to possible composition but ground checking will be required to accomplish definitive descriptions.

Dense Woods

Dense woods include those areas of apparently impenetrable expanse of tree top canopy. Terrain features are largely or completely hidden by canopy cover. The outline of the forested area is sharply defined. It can be inferred that where these areas occur along stream banks that the common riparian species may be found and on slopes or uplands species associated commonly with upland forests will be present.

Open Woods

Open woods include those areas of dark somewhat separated canopies exhibiting less distinct boundary definition. Light does penetrate the canopy and reflects off the ground beneath appearing as lighter areas on the photographic image. Some limited terrain features may be visible in this type. These woods may consist of riparian or upland forest types but restricted in canopy closure by some aspect of site quality (soil, moisture, etc.). In some cases these areas may represent areas where succession is occurring, i.e. where disturbance has occurred in the past and recovery or invasion is taking place. Common successional or invader tree species include Honey Locust, Osage Orange, Walnut, and occasionally Hackberry, Red Haw, Box Elder, or Elms. The specific ecological classification of "open woods" will require some historical information or ground truth data.

Grasslands - Scattered Trees

Grasslands with scattered trees or shrubs are distinguished from open woodlands in that the trees or shrubs occur singly and scattered but not in definable groves or patches. The area is generally lighter in color and terrain features are plainly visible. Where grazing occurs and may be responsible for the lack of tree cover, the scattered trees may commonly be one of the following species: Osage orange, Red haw, Hackberry, Coffee tree, or Ash. These species commonly occur as single trees in rangelands. Scrub or brush may be distinguished on the photography because of its sparse character and low height.

The distributions of grasslands and agricultural croplands in eastern Kansas is largely controlled by topography. The smooth, flat areas and gentle slopes are generally inhabited by these two general vegetation categories. Wooded areas surrounding these lands are typically on rougher topography, ie. steeper slopes and scarps.

Native Grassland

Native grassland or rangeland is defined as potential native or naturally occurring vegetation predominately grasses or grass-like plants and some forbs. In the photography these areas generally appear as large irregularly shaped areas of consistent grey tones. Terrain features are well defined and there are no signs of cultivation.

Tame Grassland

Tame grasslands and pastures are distinguished from native grasslands in that they are generally smaller areas having clearly definable rectangular or more regular boundaries. Where both native and tame grassland occur in smaller units, textural differences indicating cultivation or seeding techniques can be used to separate tame grassland. In addition, in color infrared photography early in the year the tame (seeded) grasslands appear bright red or pink while the native grassland appear magenta or bluish. Meadows and pastures may often appear mottled due to the patchiness of the vegetation.

Agricultural Cropland

Agricultural cropland is defined as that land used primarily for production of crops or farm commodities. The appearance of cultivated fields varies considerably with the season and the state of cultivation. Cultivated fields which have recently been plowed reflect large amounts of light and therefore are very light toned or white on the photography. Ripened crops or crops being harvested are also light in color. Most often the patterns of cropping (rows, contours, etc.) are well defined and readily distinguished. Often terrain features, particularly contours, are not only visible but may be exaggerated by contour farming.

Wildlife Habitat

Evaluation of wildlife habitat in terms of value or potential can be accomplished at several levels. Considering the area involved, the time limitations for the study, and the data base available, a generalized evaluation was conducted. The technique involved evaluating each quarter section in the study area using the following criteria: food, cover, grassland, distribution and size, interspersions, and communication. For purposes of this study food was broadly defined as agricultural cropland, cover as woodland or trees, and grassland included all three classifications although tame grasslands were weighted somewhat compared to native types. The distribution of these three vegetation types involves the spatial relationship of one type to another while size considers the areal extent of each type. Interspersions is the scattering of these different types along sampling transects, i.e. the number of times a different type occurs along the transect (Baxter and Wolfe, 1972). Communication involves the routes of travel to and from feeding areas or grasslands, e.g. wooded areas or hedge rows.

The primary data base was the vegetation map produced from the aerial photographs. Vegetation maps have commonly been used to provide an index to the biotic potential in an area. In addition to the vegetation map secondary data from a study of wildlife in the Wakarusa River Watershed (Choate, 1967) was used to aid in defining the criteria in reference to the specific study area.

Three "wildlife potential" values were used in evaluating each quarter section. It should be understood that these are only potential values and not actual wildlife counts or surveys since no field studies were conducted. The values have particular reference to upland game and song birds, however, some indication of potential for deer and some smaller mammals can be made.

High wildlife potential was classified on the basis of the presence of all three vegetation categories, a good distribution of smaller size units of each vegetation type, a high degree of interspersions, and the presence of good communication lanes.

Moderate potential required the presence of at least two of the vegetation types, balanced with a good distribution of smaller sized units, moderate interspersions, and at least some possible communication lanes or some balanced combination of the above factors any one of which may be suboptimal.

Poor potential for wildlife indicates areas where one or more of the criteria were missing entirely or very poorly represented. For example areas where only one vegetation type occurred or where communication lanes were missing.

Anticipated Use of Results

It is anticipated that this study will provide a detailed, overall view of the present conditions and land use surrounding the proposed Clinton Lake. Evaluation of the results will provide information on the interrelationship of such physical factors as drainage, topography, soils, vegetation, and man-made features. Furthermore, it is anticipated that the Lawrence-Douglas County Planning Commission will take action on the results of this study by developing the planning and zoning policies in connection with development in the Clinton Lake area. Future planning decisions will be based on the present conditions and potentials identified.

CHAIRMAN
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VICE CHAIRMAN
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NANCY KOLLMORGEN
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ROLAND W. WILLITS
LILLIAN J. WOMACK

LAWRENCE - DOUGLAS COUNTY

PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4800
EXTENSION 36

910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

March 13, 1973

Mr. Bill Barr, Executive Director
Space Technology Laboratories
West Campus, Kansas University
Lawrence, Kansas 66044

Dear Mr. Barr:

First of all, I wish to thank you for allowing the Lawrence-Douglas County Planning Department the use of your Remote Sensing Program, through the applications grant, in developing a comprehensive land use plan for the Clinton Reservoir area.

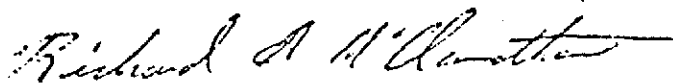
Through remote sensing, we hope to gain an overall view of the entire ninety-two (92) square mile study area. (This figure includes federal lands) In addition, we hope that this will give us a detailed view and the interrelationship of such specific physical factors as: drainage; topography; the suitability and capability of soils; vegetation; and man-made features.

We feel that utilization of remote sensing will provide our physical planning a savings in time while providing a deeper knowledge of the study area.

It is further our intention and hope that through analysis and evaluation of the data obtained from the remote sensing program additional information will be developed that could be applied to socio-economic planning.

Again, thank you for making this program available to us.

Sincerely,



Richard A. McClanathan
Lawrence-Douglas County
Director of Planning

RAM/ed

CHAIRMAN
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LAWRENCE - DOUGLAS COUNTY

PLANNING COMMISSION

RICHARD A. McCLANATHAN
DIRECTOR OF PLANNING

913-843-4600
EXTENSION 36

910 MASSACHUSETTS STREET
BOX 700
LAWRENCE, KANSAS 66044

April 18, 1973

Mr. Bill Barr, Director
University of Kansas
Space Technology Laboratories
2291 Irving Hill Drive
Campus West
Lawrence, Kansas 66044

Dear Bill:

As you requested in your letter of April 10, 1973,
I have attempted to jot down essentially what I
said during the presentation of our project at the
March 29, 1973, Governor's Conference.

If this write up needs to be edited or changed,
please feel free to do so.

Sincerely,



Richard A. McClanathan
Director of Planning

RAM/ed
enc.

Richard A. McClanathan
Director of Planning
Lawrence-Douglas County Planning Department
Project Presentation of Clinton Reservoir Land Use
Mapping for Mini-Comprehensive Plan.
Governor's Conference
March 29, 1973

During the late 1950's the U.S. Army Corps of Engineers determined that a lake or water impoundment on the Wakarusa River in Douglas County would be advantageous to the overall Kansas River Flood Protection program. At the time this project was first proposed and through the 1960's little concern was shown by the community for the project or its obvious impact. Although some community organizations attempted, during this time, to point out various problems that would be incurred there was little widespread community reaction.

However, recently, due to recreational proposals for the lake, possible urban development on the lake fringes, concern of overdevelopment and proliferation of commercial uses, considerable community concern has arisen. Because of this community concern, the Lawrence-Douglas County Planning Commission in late 1972 placed a moratorium on zoning changes in the Clinton Reservoir area and directed the planning staff to develop a mini-comprehensive plan for the area.

Clinton Reservoir is located approximately two (2) miles west of Lawrence and three (3) miles south of U.S. Highway 40.

It is expected that the recreational value of the lake will draw a considerable number of people from the south Kansas City area and the Topeka area, thus placing an unanticipated burden on the major trafficways through Lawrence and northern Douglas County. These trafficways are for the most part, presently two lane thirty (30) foot wide roads and vary in type of surfacing material from concrete to rock.

The economic and physical growth of the County and City of Lawrence will experience a considerable impact due to the lake development. However, this is somewhat conjecture on the part of local planners as there is no other lake development in the State of Kansas, or adjoining states, having this proximity to an urban center from which experience could be evaluated.

Because of the time constraints placed on the planning staff to develop this mini-comprehensive plan, the Space Technology Laboratories here at the University, offered the assistance of their remote sensing program. Through this program our study is being provided with information on surface water, cropland, trees, flora, unique scenic views, wildlife values, land use, circulation, and utilities. Other information could have been made available through remote sensing such as: drainage basins, mineral resources, and historical site values; however, at the time this information was available from other sources.

Our department has been and is very appreciative of the cooperation and assistance given us by the Space Technology Laboratories and we wish to thank them for coming to our aid.

Through the remote sensing program, we hope that an overall view of the entire ninety-two (92) square mile study area will be gained. In addition, we anticipate that the information developed here will provide us with a detailed view as well as information to determine and evaluate the interrelationship of such physical factors as: drainage; topography; suitability and capability of soils; vegetation; and man-made features.

It is also our hope and intention, that through analysis and evaluation of the data provided through the remote sensing program that information can be developed that could be applied to socio-economic planning in general.

Utilization of remote sensing is providing our physical planning with a savings in time and a deeper knowledge of the study area.

CHAIRMAN
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LAWRENCE - DOUGLAS COUNTY

PLANNING COMMISSION

RICHARD A. MCCLANATHAN
DIRECTOR OF PLANNING

913-843-4600
EXTENSION 36

910 MASSACHUSETTS STREET
BOX 708
LAWRENCE, KANSAS 66044

September 7, 1973

Mr. Bill G. Barr, Executive Director
Center for Research, Inc.
West Campus, Kansas University
Lawrence, Kansas 66045

Dear Mr. Barr:

Thank you for the contribution of the University of Kansas Center for Research, Inc., in the development of the Clinton Reservoir Area Mini-Comprehensive Plan.

The information gathered by the CRINC staff, through interpretations of aerial photographs and field surveys, included data on existing native vegetation and agriculture; earth forms; potential for wildlife habitats; and existing land use.

The Lawrence-Douglas County planning staff utilized this information to complement, and compared with, other factors compiled by our office. For instance, soil capability information provided by the Soil Conservation Service and present agricultural use areas, as compiled by the CRINC staff, were checked for correlation. The land use information allowed us to update existing base data on transportation routes and type of road surfacing; utility service systems; quarries; surface water; and residential, commercial, and industrial properties. The earth forms data assisted in locating areas having possible scenic value. Data showing areas having a high degree for potential wildlife habitat was compared with and utilized as argumentative reinforcement for the preservation of dense wood stands, marshlands, and unique topographical areas.

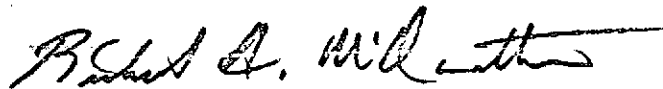
Finally, the information compiled and analyzed by both the CRINC and local planning staffs served as the data basis from which Mr. Ronald Jones, Planning Consultant, developed the proposed Clinton Reservoir Area Mini-Comprehensive Plan.

Mr. Bill G. Barr, Executive Director
Lawrence, Kansas 66045
September 7, 1973
Page 2

We would also like to emphasize that CRINC's contributions have led on to a better understanding and evaluation of many social, political, and economic factors in addition to developing an approach to physical land use planning.

We again thank you for making this program available to us and are sincerely hopeful collaboration between CRINC and the Lawrence-Douglas County planning staff will again be possible in the future.

Yours truly,

A handwritten signature in dark ink, appearing to read "Richard A. McClanathan", with a long horizontal flourish extending to the right.

Richard A. McClanathan
Lawrence-Douglas County
Director of Planning

RAM/ed

Project Title: Pattonsburg Lake Land Use Assessment

Participating Agencies: Governor's Office Mo., Water Council Mo., MGS

Key Personnel:

Agency: Mr. Robert Lindholm and
Mr. Marvin Nodiff
Executive Office of Missouri 314/751-2368
Dr. George Smith, Director
Water Resources Res. Center 314/882-3421
Bill Allen
Missouri Geol. Survey 314/364-1752

CRINC: B. G. Barr
Robert L. Walters
Robert J. Eastmond
Ted L. Talmon

Tentative Completion Date: 31 July 1973

Starting Date: 1 June 1973

1.0 Introduction:

Pattonsburg Lake is a key project for development of the 7,900 square mile Grand River Basin. The Lake would have a 42,000 acre surface in the multipurpose pool and a full pool area of 77,000 acres. Included in the purpose for the Lake are flood control (Grand River & Missouri River basins), power generation, and recreation. The project is located in Daviess, DeKalb, Gentry and Harrison Counties, Missouri, northeast of Kansas City. An environmental statement has been prepared and is presently being evaluated by the Governor's Office and the Missouri Water Council. Upon request from the Office of the Governor, the Applications Program will provide supplemental land use and water data critical to the impending decision on the Lake.

2.0 Statement of Work

2.1 Objectives: The primary objective of this project is to supply the Governor's Office and the water council with information concerning land use, both in the lake area and the flood prone area down river to the Missouri River. The remotely sensed information will provide up-to-date data. Several specific information needs have been requested in addition to conventional remotely sensed data such as flooding extent during this spring's flood and land use acreages.

2.2 Approach: The Applications staff, working closely with the Governor's Water Council, Governor's Office, U. S. Army Corps of Engineers, Missouri Geological Survey and Missouri Department of Community Affairs, will utilize ERTS imagery supplemented by medium altitude photography to determine existing land use overlays, acreage descriptions, and flooding information.

2.3 Anticipated Results: The results of this study will provide the Governor of Missouri with data to assist him in an independent review of the proposed Pattonsburg Dam project. The information will be utilized by the Governor's Council on Water Resource Planning, specifically organized to aid in decision making concerning the Pattonsburg Lake project. The Governor has requested the recommendations of the Council by a 31 July deadline. Resting upon this decision is the pressing decision as to the type of crossing structure for I 35 which crosses the lake area.

APPLICATION OF REMOTE SENSING
TO LAND USE CLASSIFICATION AND FLOODING
IN THE PATTONSBURG LAKE AREA
GRAND RIVER BASIN, MISSOURI

Robert J. Eastmond
Ted L. Talmon

in cooperation with the
Executive Office, State of Missouri
Missouri Clean Water Commission
Governor's Council on Water Resource Planning

Technical Report 2230-19

August 1973

(Partially supported by NASA Grant NGL 17-004-024)



THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
2385 Irving Hill Rd.—West Campus Lawrence, Kansas 66044

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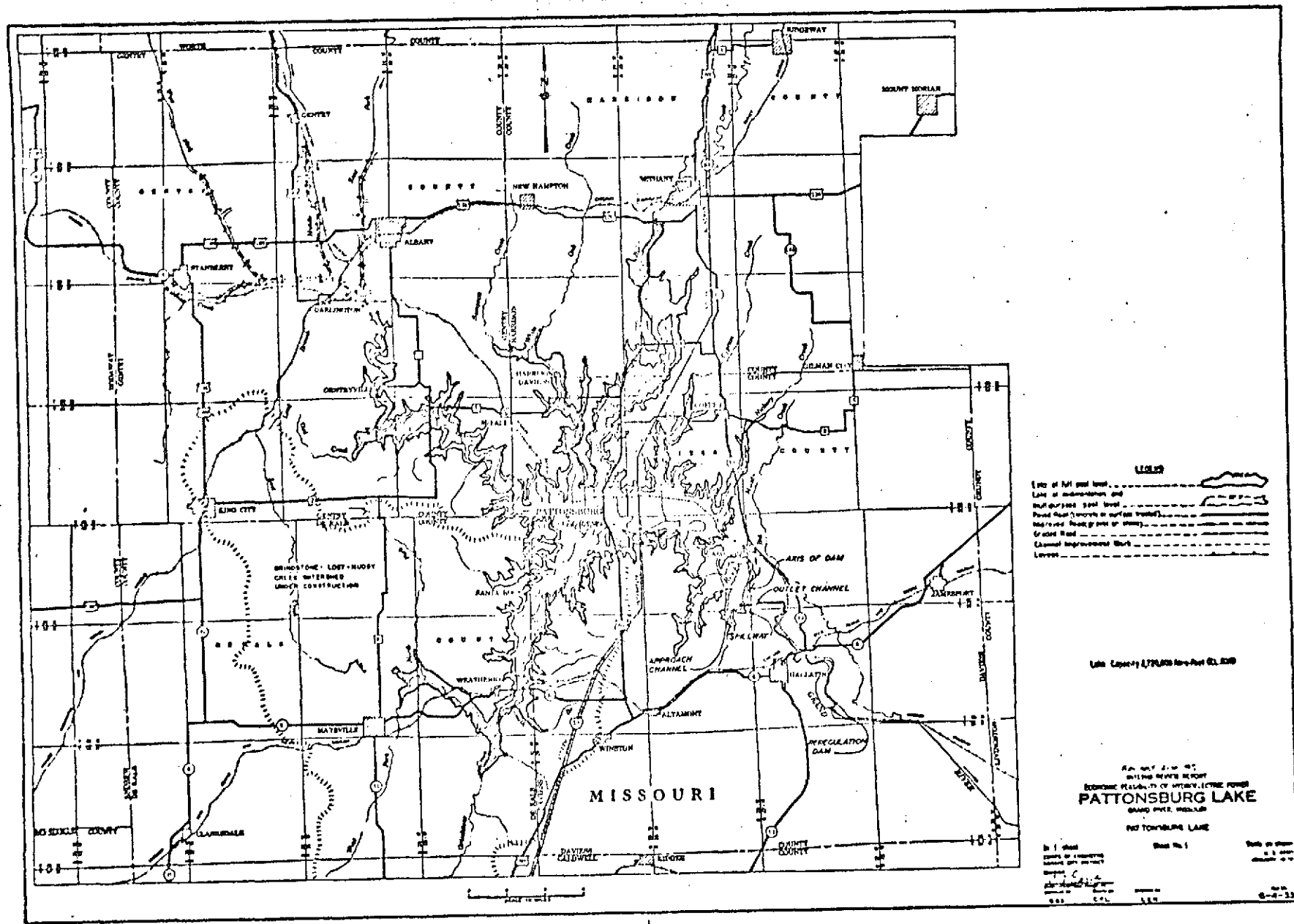
INTRODUCTION

The proposed Pattonsburg Lake is part of the Grand River Basin comprehensive flood control and water resource development plan. This plan outlines a system of multiple use lakes and stream improvement projects in the 7,900 square mile Grand River Basin of Missouri and Iowa. The proposed lake is located in Daviess, DeKalb, Gentry and Harrison Counties of Missouri, northeast of Kansas City. The dam would be located on the Grand River about five miles north of Gallatin, Missouri (Figure 1). The purpose of the lake includes flood control, recreation, and power generation. The lake would have a 42,000 acre surface in the conservation pool and an area of 77,000 acres at full flood pool.

OBJECTIVES

The primary objective of this study is to provide specific information to the Governor of Missouri and to the Governor's Council on Water Resource Planning (Appendix A). This information will supplement the findings reported in the Environmental Impact Statement prepared by the U. S. Army Corps of Engineers. The results of the study will assist the Water Council and the Governor in the decision-making process concerning Pattonsburg Lake.

There are two areas of particular interest, the area to be inundated by the lake, and the area from below the dam to the confluence of the Grand and Missouri Rivers near Brunswick, Missouri. In the area to be inundated by the lake, a determination was made of the existing land use. This determination was made separately for the area within the conservation pool boundary and for the area within the "lease back" flood pool boundary, i.e., that area from the conservation pool to full flood pool. For the area below the dam, the land use along the Grand River from the dam site to the Missouri River was determined within the spring, 1973 flood boundaries.



DATA SOURCE

Aerial photography was obtained covering the lake area and the Grand River flood plain from the dam site to the Missouri River on three separate dates. Color infrared (Kodak 2424) and black and white infrared (Kodak 2443) vertical imagery was obtained on all three dates. An 89B filter was used in combination with the color infrared film and a Wratten 15 filter was used with the black and white film.

On 25 May 1973, photography was obtained from 10,000 feet MSL, utilizing a Hasselblad two-camera cluster flown in the Center's C45J twin engine aircraft. The scale of the photography was approximately 1:75,000 covering the flood plain below the dam site. On 11 June 1973, photography was obtained for the eastern half of the proposed lake area from Pattonsburg to Gallatin. This imagery was obtained from 14,000 feet MSL at a scale of approximately 1:102,000. This same scale was used to obtain photographic coverage of the remaining western half of the lake area on the 20th of June. Also on 20 June 1973 additional photography was obtained for the downriver flood plain at 1:102,000 scale.

Imagery from the Earth Resources Technology Satellite (ERTS-1) was used in conjunction with the aerial photography to determine the flood limits of the spring, 1973 flooding along the Grand River. The 9 May 1973, MSS - 7 imagery was used for this purpose (Figure 2).

METHODS

The accomplishment of the objectives related to land use required photo reading and analysis of the aerial photographs obtained. This process involves recognition of an object or an area on the photograph. The recognition is usually defined in terms of tone, shape, and pattern. Cross referencing this information with supplemental data such as maps or ground observations helps confirm the interpretation. For purposes of this study four general recognition categories were defined: urban land, agricultural land, pasture land, and forest land.

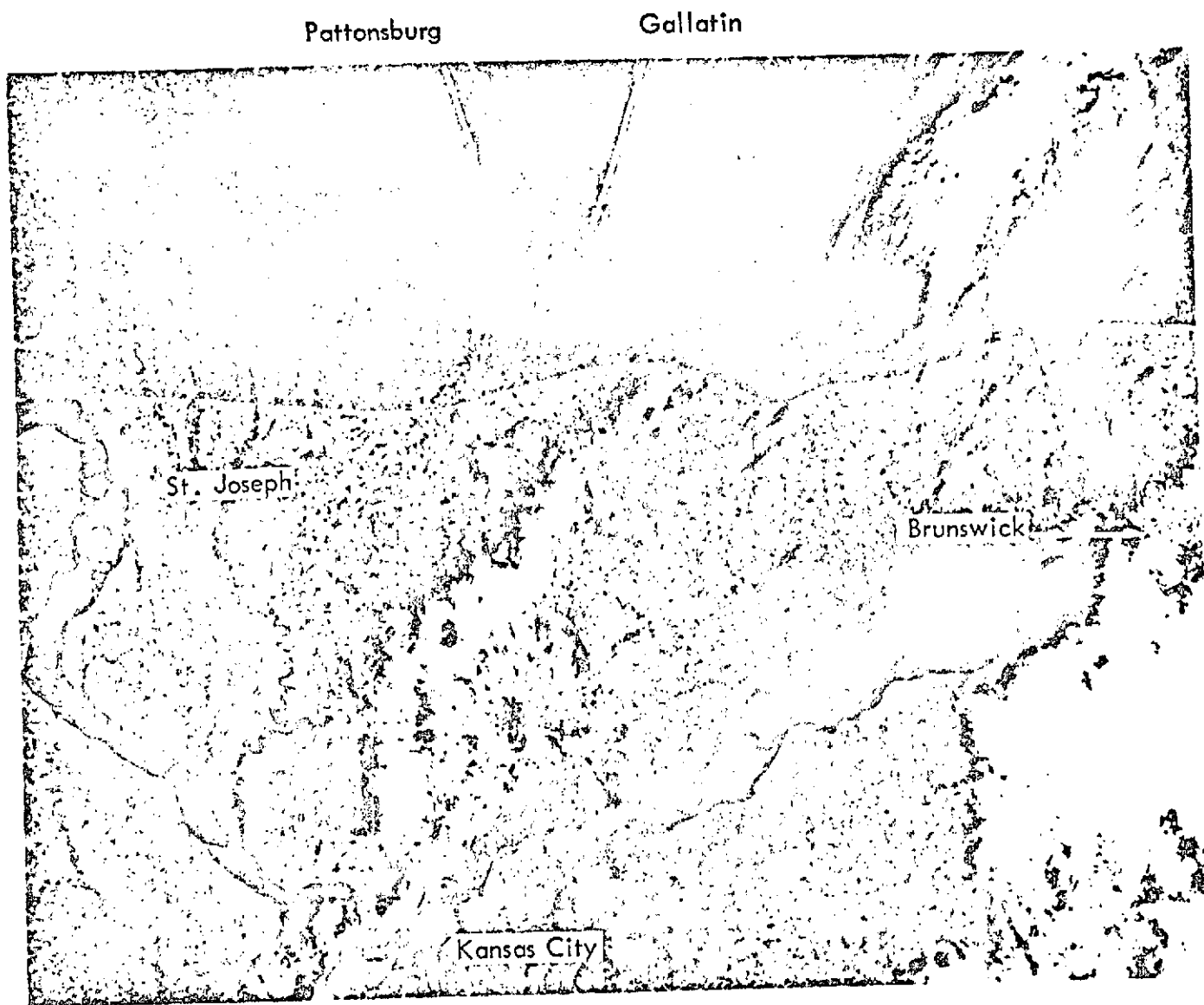


Figure 2. 9 May 1973, MSS-7 ERTS-1 imagery showing the Pattonsburg Lake area northeast of Kansas City, Missouri. Scale 1:1,000,000

Urban land includes towns or mixed residential and commercial settlements. Agricultural crop land is defined as that land used primarily for production of crops, and was identified by dark tones of bare, plowed ground or by cultivation patterns. Pasture land is primarily grassland used for grazing and was identified by its lighter tones. Often times pasture lands have scattered trees or well defined paths further characterizing the identification pattern. Forest land is distinguished by the presence of numerous trees or closed tree canopy.

Once the boundaries of land use categories were delimited on 1:62,500 scale enlargements, the boundaries were transferred to a scale overlay showing the lake boundaries. The conservation pool boundary was the 810 foot contour and the flood pool boundary the 840 foot contour. Following this transfer, the acreages for each classification were determined by using a Hewlett Packard 9107A Digitizer and 9100B Calculator.

The downstream area was analyzed by transferring the wet soils boundary, as complete as possible, from the 9 May 1973 ERTS-1 imagery to an aerial photo mosaic reproduced at 1:62,500 scale. The area within these boundaries was then analyzed and classified according to the recognition categories described earlier. The approximate acreages were determined as before.

RESULTS

The total surface area of the lake at full flood pool as measured from the overlay is 80,061 acres. Of that total, 37,153 is within the conservation pool and 42,908 acres is in the "lease back" flood pool between the 810 and 840 foot contours. These figures differ slightly from those given in the Environmental Impact Statement. This difference is due primarily to the fact that the MSL contour of the conservation pool used in the impact report is 811 feet and the full pool 836 feet while in this study the 810 and 840 foot contours respectively were used.

Within the conservation pool area 23,387 acres or 62.9% of the area is presently crop land, 5.6% or 2,072 acres is pasture, 11,500 acres or 31.5% is forest, and 194 acres is urban land. The "lease back" flood pool land is also primarily agricultural crop land. This category covers 24,480 of the 42,908 acres or 57.0% of the area. Pasture land covers 4,571 acres, or 10.7%, forest lands cover 13,844 acres or 32.3%, and urban land use accounts for only 13 acres in this area. These figures are summarized in Table 1 and the areas are shown in Figure 3.

Table 1

Category	Conservation Pool Area in acres	Percent of total
Cropland	23,387	62.9
Pasture	2,072	5.6
Forest	11,500	31.0
Urban	194	0.5
Total	37,153	

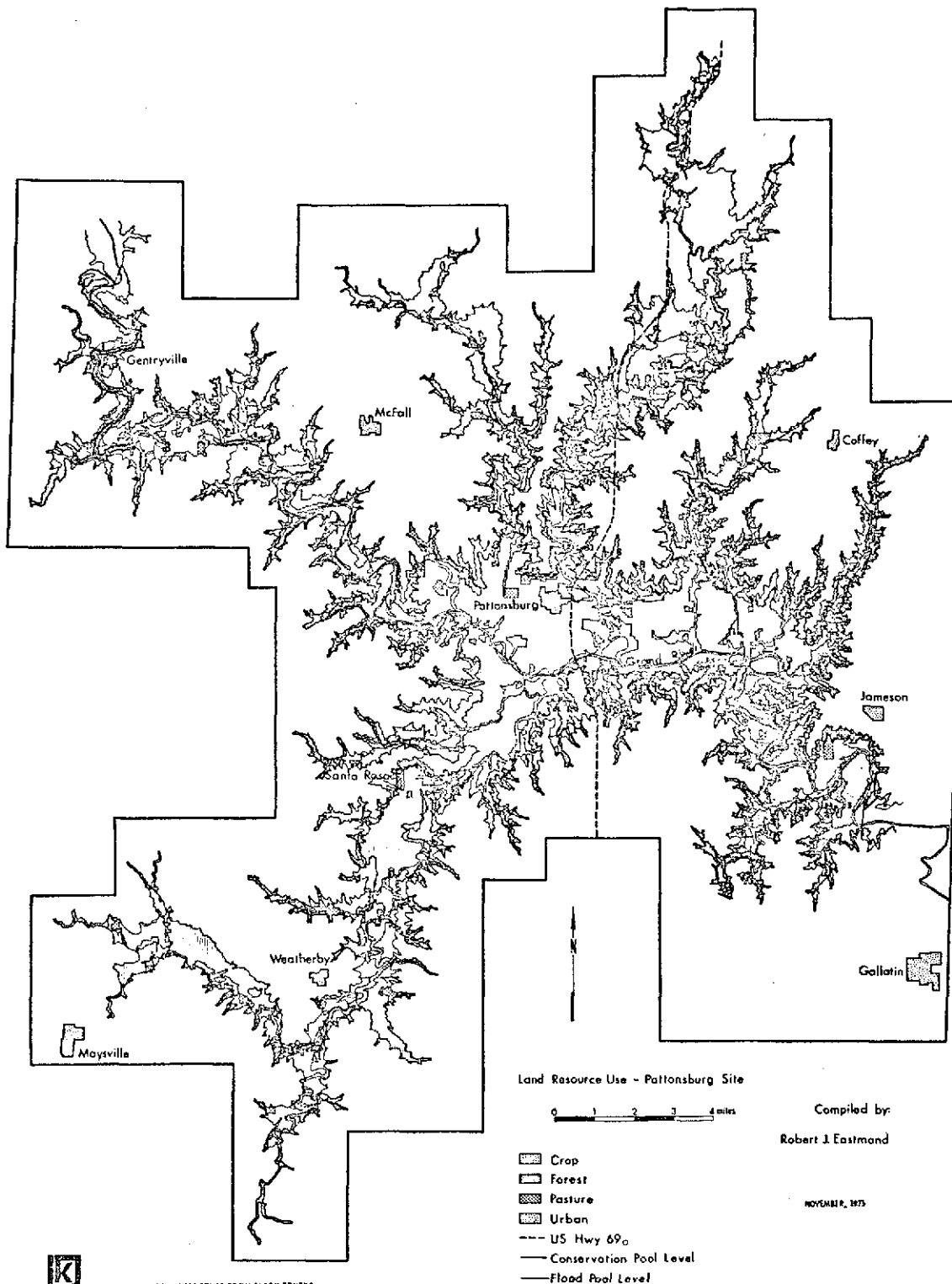
"Lease Back" Flood Pool

Cropland	24,480	57.0
Pasture	4,571	10.7
Forest	13,844	32.3
Urban	13	--
Total	42,908	

Totals in Full Flood Pool

Cropland	47,867	59.8
Pasture	6,643	8.3
Forest	25,344	31.7
Urban	207	0.2
Total	80,061	

According to the USDA Survey in 1967 the Grand River Basin as a whole was characterized as 62.8% cropland, 19.2% remanent pasture,



THE UNIVERSITY OF KANSAS SPACE TECHNOLOGY CENTER

14.9% forestland, and 3.1% other. The variations of these values with those of the Pattonsburg Lake area reported above can be resolved on the basis of the location of the lake area. The lake area is located in low-lands of the Grand River and its tributaries. This leads to the higher proportion of forest as opposed to pasture, considering the river bottom habitat and associated woodlands along the Grand River and the lower wooded scarps associated with the tributaries.

Downstream in the area between the Pattonsburg Dam site and the confluence of the Grand and Missouri Rivers there are about 113,000 acres of cropland, 3,000 acres of pasture, 16,000 acres of forest and 2,000 acres of urban land and wildlife reserve lakes. The total area within the boundaries of this year's flooding is about 134,000 acres. This figure comes very close to the 133,180 acres described in the environmental statement as being subject to flooding.

The alternative using the wet soil boundary transfer method involving satellite imagery and aerial photography was selected because the boundaries of the 100 year project design flood and the flood levels for the 1947 base flood had not yet been obtained. The wet soil boundaries depicted of the 9 May 1973 ERTS-1 imagery were highly correlated with the same boundaries interpreted from the black and white infrared aerial photography. This technique has been shown to be an effective use of satellite imagery.¹

SUMMARY

This project has described the present land use of the area to be inundated by the proposed Pattonsburg Lake. It also provides information on the land use and acreages which would theoretically be protected by the proposed flood control dam. The project has involved the application of both aerial photography and satellite imagery to specific objectives in environmental impact analysis and land use decision making.

¹Hallberg, G. R., B. E. Hoyer, and A. Rango. "Application of ERTS-1 Imagery to Flood Inundation Mapping." In: Symposium on Significant Results Obtained from ERTS-1, Vol. 1, Goddard Space Flight Center, New Carrollton, Maryland, March, 1973, p. 745-753.

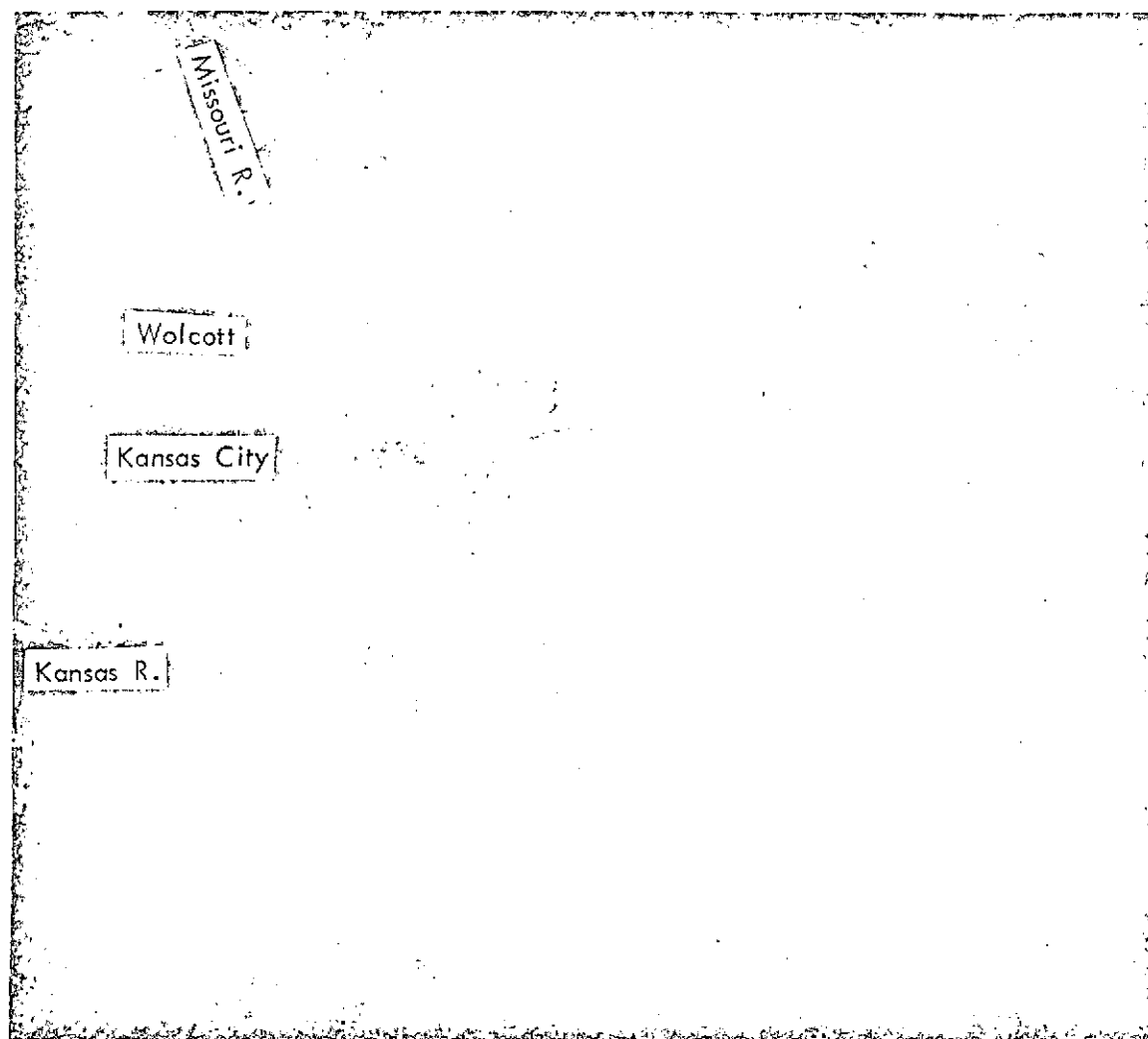
Kansas Applications Program Flood Threat
Interpretation in Support of Kansas City, Kansas

Major flood threats developed along both the Missouri and Kansas Rivers at Kansas City, Kansas on 12 Oct. 1973 (Fig. 1). Since hazards simultaneously posed to the extensive residential, industrial and transportation activities on these floodplains required accurate and timely data to facilitate the distribution of limited personnel and resources to counter both threats, Mr. Thomas Palmerlee of the Kansas City Planning Office requested the assistance of the Kansas Applications Program in the acquisition of suitable data.

The request was received at approximately 1430 hours on 12 October 1973. The CRINC aircraft, equipped to obtain black and white 70 mm aerial photography, departed Lawrence two hours later, obtained photographs over both the Missouri and Kansas River valleys. The photographs were immediately processed and interpretation commenced about 2030. Results were telephoned to Mr. Larry Payne, Civil Defense Duty Officer, who directed onsite inspections of all problems noted on the photography. Primary problems observed were (1) the broken dike adjoining the Turner mobile home park, (2) seepage through the dikes protecting the Argentine and Armordale industrial districts and the Phillips oil refinery, (3) possible flooding around the Fairfax thermal power plant, and (4) development of a log jam against a floating crane at the I-435 bridge under construction.

Since crest arrival had been delayed, a second mission was requested on 13 October. Coverage was acquired by 1100 and interpretation began at 1400. Attention was focused on the Wolcott area north of Kansas City (Fig. 2). A total of four breaks in the dikes were identified and water approach to the town was evaluated. Other key problems (Fig. 3) first identified from the photography were a barge lodged against the I-435 bridge under construction and a molasses tank lodged against the Fairfax bridge. Other problem areas evaluated included (1) storm sewer backup in Armordale, (2) flooding of the Santa Fe scrap facility, (3) dike erosion along the Union Pacific-Rock Island rail yards, and (4) flooding around the Fairfax thermal power plant.

EXHIBITS AVAILABLE ON REQUEST



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Figure 1. Kansas City, Kansas on 15 Oct 1973. This ERTS-1 MSS-5 image shows the continued presence of water on the Missouri River floodplain but the Kansas River is again within its banks.

FLOODING NEAR WOLCOTT, KANSAS, 13 OCT 1973



Figure 2. Mosaic of aerial photographs showing two of the four breaks in the Missouri River levee which threatened the town of Wolcott.

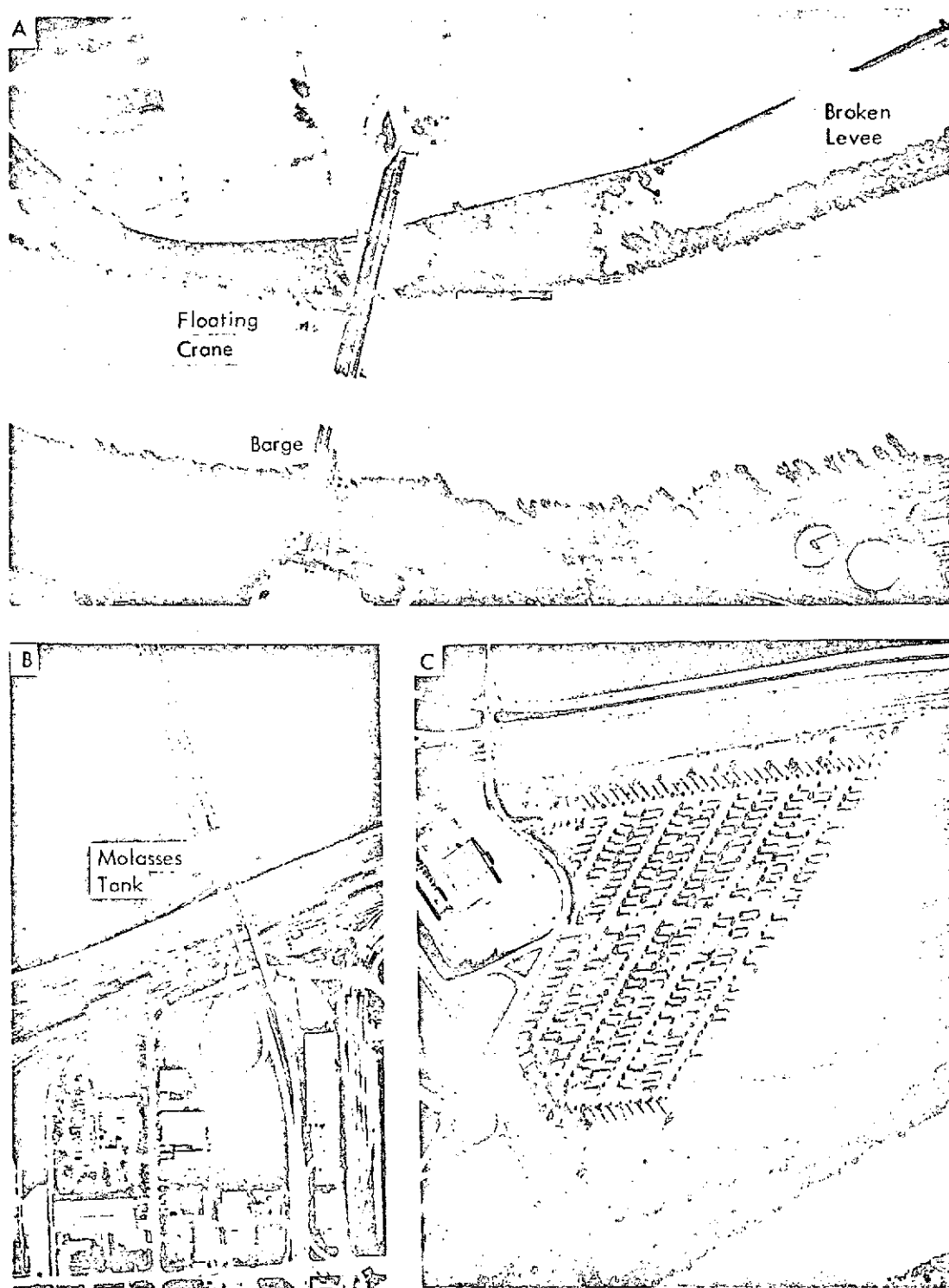


Figure 3. Selected scenes of flooding along the Missouri and Kansas Rivers on 13 Oct 1973. A. I-435 bridge under construction over the Missouri River. Pressure on the floating crane from the log jam caused it to break loose and lodge against the bridge later in the day. Note the rapid flow through the broken levee and the barge lodged against the south end of the bridge. B. Molasses tank against the Fairfax bridge over the Missouri River. C. Flooding in the Turner mobile home park from the Kansas River.

Based on this information, Civil Defense personnel (1) shifted sandbagging operations at Wolcott from Connor Creek to the railroad track west of the town, (2) informed the State Highway Commission of conditions at the two bridges, and (3) transferred most effort to the Missouri River since the imagery indicated that flooding had been contained along the Kansas River.

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EXECUTIVE OFFICE
STATE OF MISSOURI
JEFFERSON CITY

CHRISTOPHER S. BOND
GOVERNOR

May 10, 1973

Dr. William Barr, Director
The University of Kansas Center
for Research, Inc.
2291 Irving Hill Road - Campus West
Lawrence, Kansas 66044

Dear Bill:

On behalf of all of us who were able to meet with you, Bob Walters and Bob Eastmond, may I offer our sincere thanks. I am very hopeful that better utilization by our state agencies, and increased inter-agency cooperation will result from the meeting.

We would like to ask you whether you could supply us with some information on the Grand River in Missouri. Enclosed please find two maps to help determine the area to be studied.

The data we need will be concerned with the proposed Pattonsburg Dam project, to determine existing land use patterns both in the areas which would be inundated and the new areas below the dam which would become more useful. If we are supplied with ERTS or high-altitude or middle-altitude imagery, we would, of course, need your help in interpreting the data to determine land use in the areas. We would also be able to utilize your data on the lands covered by the recent flooding to determine those areas to be protected by the project.

The information would be for Governor Bond to assist him in his independent review of the proposed Pattonsburg Dam project. The information would be utilized by the Governor's Council on Water Resource Planning which he has established to assist in this decision-making process.

Dr. William Barr
May 10, 1973
Page 2

Since the Council must have all of its information together in order to provide the Governor with its recommendation by July 31, it hopes to have accumulated all of its research material by the end of June. In this case, however, we could utilize information provided by you closer to the July 31 deadline.

We would appreciate knowing whether you would be able to work with us on this tight time schedule. Once again, thank you for your kind assistance. We look forward to a close and beneficial working relationship with you.

Sincerely yours,

A handwritten signature in cursive script, reading "Marvin J. Nodiff". The signature is written in dark ink and is positioned above the printed name and title.

Marvin J. Nodiff
Program Assistant

MJN:cw

Enclosures

University of Missouri
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Attachment A(2)



WATER RESOURCES RESEARCH CENTER
Office of the Director

Telephone
314-882-3421

424 Clark Hall
Columbia, Mo. 65201

May 24, 1973

Dr. Robert Eastmond
Space Science Center
2291 Irving Hill Drive
University of Kansas - West Campus
Lawrence, Kansas 66044

Dear Dr. Eastmond:

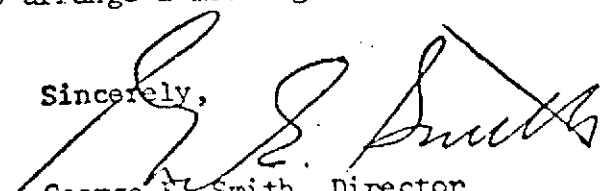
Under separate cover we are sending you a copy of the Draft Environmental Impact Statement for the Pattonsburg Lake (Missouri). This material contains maps and historical material that will furnish you background material. Enclosed is an analysis of the power facilities that is a later authorization.

As we discussed on the phone I believe that information you could secure on land use and moisture conditions now would be useful to our group. There are two district areas of interest (a) above the dam where land will be used for water storage, flood water retention and access area, and (b) the flood plain of the Grand to its joining the Missouri. This last area will receive benefits from reduced flooding.

Any land use information your method could provide should be useful. Probably an indication of water content of surface soil would be most valuable. A mapping of land that is or has been under water this season, a designation of cultivated crops, grass and forest acreage and location would be helpful. At this time a measure of the amount of land that has been cultivated this spring would be meaningful. I doubt that any recently planted crops will show much surface soil differences between species. Can you distinguish between soil types that might show differences in color or heat accumulation due to moisture?

We appreciate your interest and assistance. Let me know if we can provide any information. We will be happy to arrange a meeting with our group if it will be useful.

Sincerely,


George E. Smith, Director

jg

cc: Marvin Nodiff
Bob Lindholm

APPLICATIONS SUMMARY SHEET

Appendix (d)

Project Title: Using Remote Sensing for a Wildlife Habitat Inventory of Kansas

Participating Agencies: Kansas Forestry, Fish and Game Commission

Key Personnel:

Agency:

Mr. Keith Sexson
Small Game Research
Kansas Forestry, Fish & Game Commission
229 West 15th Street
Emporia, Kansas 66801

Mr. Jim Norman
Federal Aid Coordinator
Box 1028
Pratt, Kansas 67124

CRINC:

B. G. Barr, Project Director
Robert Walters, Coordinator
Robert Eastmond, Program Scientist
Jim Merchant, Research Scientist

Tentative Completion Date: August, 1974

Starting Date: 12 February 1973

1.0 Introduction:

The Kansas Forestry, Fish and Game Commission is charged with the responsibility of managing the wildlife resource of the state. An integral part of the data base for any wildlife management operation must be an inventory of the spatial distribution, aerial extent, and degree of interspersation of current and potential wildlife habitat types. In addition, there must exist the capability to update this inventory at regular intervals. Current modes of data collection are much too cumbersome, and are not adequate for the type of state-wide habitat survey which is required. The Forestry, Fish and Game Commission is, therefore, extremely interested in assessing the capabilities of remote sensing for acquisition of habitat information.

2.0 Statement of Work

2.1 Objectives:

The primary objective of this project is to assess the utility of high altitude (40,000 to 60,000 ft) aerial photography, and secondarily, ERTS as means to inventory the wildlife habitat of the State of Kansas. This will be done both from a technical as well as a cost-benefit standpoint, and will be totally based on user requirements. A secondary goal of this investigation is to aid the Kansas Forestry, Fish and Game Commission in establishing an independent interpretative and data processing capability in the area of remote sensing.

2.2 Approach:

High altitude aerial photography, appears to provide both the high resolution and the expansive spatial coverage necessary for a statewide habitat inventory. ERTS is believed to be of secondary value, but may have considerable utility as a tool for repetitive monitoring of regional change in habitat condition.

Both of these sensors will be analyzed with regard to their capabilities for inventory of habitat in a pilot study. NASA has been requested to provide coverage of all or part of three counties representative of the major ecological units of the state — the short grass prairies (Thomas County), mixed prairie (Ottawa County), and tallgrass-woodland mosaic (Jefferson County). In the interim, available imagery of Kansas is being utilized to develop interpretation, data extraction and data storage strategies. Current ERTS, 1969 high altitude aerial photography of Douglas County, and selected frames of March, 1973 high altitude photography of Finney, Saline and Jefferson Counties are being used in this work.

Kansas Forestry, Fish and Game Commission personnel have been engaged in all major project decisions and will be actively participating in all phases of the pilot study.

2.3 Anticipated Results:

It is believed that the results of the pilot study will be positive from the standpoint of extraction of required data. Cost-benefit results appear somewhat less encouraging, but perhaps, may serve as a catalyst to encourage cooperation and pooling of funds from several state agencies, all of which would profit from the data. A cooperative effort of this scope is under active discussion in Kansas, and will be actively considered and incorporated in development of this and other projects which might conceivably be affected.



THE UNIVERSITY OF KANSAS / CENTER FOR RESEARCH, INC.

Irving Hill Rd.— Campus West Lawrence, Kansas 66044

APPLICATIONS SUMMARY SHEET

Project Title: Using Remote Sensing for a Wildlife Habitat Inventory of Kansas

Participating Agencies: Kansas Forestry, Fish, and Game Commission;
CRINC Remote Sensing Application's Personnel

Key Personnel:

Agency:

Mr. Bruce Waddell
934 Frazier Street
Valley Falls, Kansas 66088

Mr. Keith Sexson
Small Game Research
Kansas Forestry, Fish, & Game Commission
229 West 15th Street
Emporia, Kansas 66801

Mr. Jim Norman
Federal Aid Coordinator
Box 1028
Pratt, Kansas 67124

CRINC:

J. W. Merchant
R. L. Walters
B. G. Barr

Date: November 12, 1973

1.0 INTRODUCTION

The Kansas Forestry, Fish and Game Commission is charged with the responsibility of managing the wildlife resource of the state. In these times of environmental awareness the maintenance of healthy natural systems would, in itself, merit careful attention to decision-making with regard to wildlife. Additionally, however, hunting and related outdoor activities are major revenue producing concerns in Kansas. These considerations mean that decisions made by the Forestry, Fish and Game Commission must be made on the basis of as accurate and timely data as possible.

An integral part of the data base for any wildlife management operation must be an inventory of the spatial distribution, aerial extent, and degree of interspersion of current and potential wildlife habitat types. In addition, there must exist the capability to update this inventory at regular intervals.

To date in Kansas the only intensive inventories of this scope have been conducted on public land near state lakes and reservoirs or on other land where a local problem has been recognized. Areas covered are usually not in excess of several sections. A much more extensive inventory is needed. The importance of this may be realized if one considers that 95 per cent of the small game harvest in the state is off of private land, almost all un-inventoried.

Current modes of data collection (largely "pencil and paper") are much too cumbersome and inaccurate for the type of state-wide habitat survey which is required (some data, for example, is now obtained by rural mail carriers who report game and habitat conditions as they travel through their routes each day). The Forestry, Fish and Game Commission is, therefore, extremely interested in assessing the capabilities of remote sensing for acquisition of habitat information.

2.0 PROJECT STATUS

2.1 Objectives

The primary objective of this project is to assess the utility of high altitude (40,000 to 50,000 ft.) aerial photography and, secondarily, ERTS as means to inventory the wildlife habitat of the state of Kansas. This will be done both from a technical as

well as a cost-benefit standpoint, and will be totally based on user requirements. A secondary goal of this investigation is to aid the Kansas Forestry, Fish and Game Commission in establishing an independent interpretative and data processing capability in the area of remote sensing.

2.2 Approach

The chronological development of this project is outlined and projected in Table I (attached). In summary, high altitude aerial photography appears to provide both the resolution and the expansive spatial coverage necessary for a statewide habitat inventory. ERTS is believed to be of secondary value, but may have considerable utility as a tool for repetitive monitoring of regional change in habitat condition.

Both of these sensors are being analyzed with regard to their capabilities for inventory of habitat in a pilot study. NASA has been requested to provide coverage of all or part of three counties representative of the major ecological units of the state--the short grass prairies (Thomas County), mixed prairie (Ottawa County), and tallgrass-woodland mosaic (Jefferson County). In the interim, available imagery of Kansas is being utilized to develop interpretation, data extraction and data storage strategies. Current ERTS, 1969 high altitude aerial photography of Douglas County, and selected frames of March, 1973 high altitude photography of Finney and Jefferson Counties are being used in this work.

Kansas Forestry, Fish and Game Commission personnel have been engaged in all major project decisions and are actively participating in all phases of the pilot study. A recent letter indicative of this cooperation is attached. Mr. Bruce Waddell (a wildlife biologist) has been hired by the agency to work full time on this project.

2.3 Results to date

Work to date has concentrated on available high altitude (65,000 ft.) color infrared imagery of Jefferson County, Kansas. This imagery was flown somewhat higher than we would like, was not collected at an optimal time of year (March), and was accompanied by no ground truth. Nevertheless, it has been useful in several ways:

1. it has aided in the development of a habitat mapping legend viable from the standpoint of the imagery limitations and, equally important, useful to Forestry, Fish and Game resource managers;
2. it has aided in the development of image interpretation and data recording techniques specialized for the habitat mapping problem; and
3. it has provided a basis of interaction between F F and G and CRINC personnel, helping us each become aware of the others needs and problems.

Working on the Jefferson County imagery we have decided to make the 10 acre cell our basic unit of classification. Within each cell dominant and secondary habitat types are indicated. Commensurate with agency requirements, all data recording is being oriented toward computer storage, retrieval, processing and mapping. Mapping and recording of wildlife habitat data in Jefferson County is now in progress. Techniques developed for the Jefferson County imagery should be fully transferable to the more optimal imagery we hope to acquire from NASA overflights in May or June, 1974. This imagery will also provide coverage of areas having differing habitat conditions allowing expansion and modification of present work as required.

Among various other related activities, we are contacting state and federal agency personnel in all fifty states to evaluate the status of work having similar focus in other areas of the country. This should help prevent needless overlap of effort and establish useful dialogues among interested parties.

2.4 Projection

Work is progressing as outlined in Table 1. It is believed that the results of the pilot study will be positive from the standpoint of extraction of required data. Cost-benefit results appear somewhat less encouraging, but, perhaps, may serve as a catalyst to encourage cooperation and pooling of funds from several state agencies, all of whom would profit from the data. A cooperative effort of the scope is under active discussion in Kansas (among personnel of the Fish and Game Commission, as well as others) and will be actively considered and incorporated in development of this and other projects which might conceivably be affected.

TABLE I

Temporal Development of Kansas Forestry
Fish and Game Project

- Nov., 1972- January, 1972-Initial contracts; expression of agency interest in conducting a study of the feasibility of using remote sensing to inventory wildlife habitat on a statewide basis.
- Feb., 1973- List of possible informational requirements presented by agency; indication that agency is preparing to hire personnel to work in a remote sensing program; initiation of a feasibility study of various sensor-platform combinations with regard to informational requirements of the agency by K. U. CRINC personnel.
- May, 1973- Results of feasibility study, revised informational requirements, and proposed land-use/habitat classification discussed with agency; cooperative plans for pilot study using high altitude photography initiated.
- June-August- 1973-Sites for pilot study chosen (Jefferson, Ottawa, Thomas Counties); agency indicates remote sensing personnel to be available by September 15, 1973 to aid in pilot study and serve as permanent CRINC-agency liaison; 1969 high altitude photography of Douglas County, Ks. ordered; ERTS capabilities discussed with agency and sample imagery annotated and forwarded; initial efforts to obtain copies of March, 1973 high altitude (U-2) imagery over selected areas of state (Jefferson, Saline, Finney Counties) from Kansas Geological Survey.
- Sept.-Feb.- 1973-Mr. Bruce Waddell employed by agency to work full time on project; interpretation of Jefferson County (March, 1973) high altitude and ERTS imagery; determination of suitable interpretative and mensural techniques; comparison of these sensors, development of computer programs for data storage, manipulation, and retrieval; establish more intensive working relationships and active cooperation between CRINC and agency remote sensing personnel.

- Dec., 1973- Date of NASA overflight-(projected)-On going attempts to meet decision making requirements of F, F and G resource managers (focus on local problems where possible with available imagery); possible testing of automatic interpretation of ERTS imagery using magnetic tapes.
- Date of NASA Overflights-August 1974-(projected) Flights over test sites conducted by NASA; interpretation of imagery by CRINC and agency personnel; information extracted as in actual operation; cost-benefit analysis; results evaluated by agency.
- 1974-1975 (projected)-Agency contracts privately for statewide coverage and initiates own remote sensing interpretation activities (perhaps cooperatively with other state agencies); CRINC personnel assume a consulting or advisory role.

* Dates must be considered best estimates dependent on flight dates, receipt of imagery, and other variables.

Project Title: Remote Sensing Study of Clinton Reservoir and Clinton Dam Site

Participating Agencies: U.S. Army Corps of Engineers

Key Personnel: Dr. Dellwig and M. Arif Yukler

Agency: John Moylan
Charles Rucker
U.S. Army Corps of Engineers

CRINC: Prof. L.F. Dellwig, Geology
Arif Yukler, Research Assistant
Robert Walters, Coordinator

Tentative Completion Date: September 1, 1973

Starting Date: March 15, 1973

1.0 Introduction:

The study of the Clinton Reservoir site evaluating multiband photography as a tool for pre- and post-impoundment detection of surficial and shallow subsurficial geologic and hydrologic conditions.

2.0 Statement of Work

2.1 Objectives:

1. Evaluation of existing imagery.
2. Multispectral coverage during the period of defoliation and after the period of defoliation.
3. Coverage of the area in spring.
4. Coverage of the area in summer.

2.2 Approach:

Bands will be studied individually and also in combinations to detect as many parameters as possible. Anomalies will be investigated in an effort to determine their origin. Anomalies will be correlated with the base and existing photography and will be tried to find their origins.

2.3 Anticipated Results:

1. An overall evaluation of multispectral photography in this environment.
2. The potential of utilization of a single or combination of bands for evaluation of geologic, hydrologic and botanical data.
3. An evaluation of multispectral photography for detection of time dependent changes, i.e., vegetation, soil moisture content, etc.
4. A summary of changes detected which appear to be related to the construction of the dam.
5. Corps of Engineers expects to fund follow-up project to monitor change after impoundment of water.

2.4 Funding:

Initiated by Applications Grant, Douglas County Study. This work now funded by Corps of Engineers contract for \$1,800.

Project Title: A Regional Land Use Map for the Four Rivers Resource Conservation Development Project

Participating Agencies: U.S.D.A. Soil Conservation Service at Salina, Kansas

Key Personnel:

Agency:

Donald R. Robertson, State Resource Conservationist
Robert K. Griffin, Deputy State Resource Conservationist
U.S.D.A.-S.C.S., 760 S. Broadway,
P.O. Box 600, Salina, Kansas,
67401, 823-9534
Jim Habigar, Four Rivers RC&D Coordinator

CRINC:

B. G. Barr, Project Director
Bob Walters, Coordinator
Robert Eastmond, Professor of Botany
Ted L. Talmon, Research Assistant
Ron Shaklee, Research Assistant
Don Williams, Research Assistant

Tentative Completion Date: October 22, 1973 **Starting Date:** April 1, 1973

1.0 Introduction:

The Four Rivers Resource Conservation and Development Program in an eight county area in North Central Kansas has requested the Space Technology Center to investigate the feasibility of producing an up-to-date land use map of the eight county area. The Four Rivers RC&D program has the responsibility of planning and developing the natural resources of this area. A land-use map taken only from ERTS imagery is expected to provide a general overview as to the type of land-use taking place in this RC&D district.

2.0 Statement of Work:

2.1 Objectives:

In creating the land-use maps, the U.S.D.A. Soil Conservation Service in Salina, Kansas has cooperated in supplying the Space Technology Center with materials and information for the final products. Materials and information used include base maps of each county, herculene drafting material for the overlays, and soil survey maps of the eight county area.

It was agreed upon by the Four Rivers Resource Conservation and Development Executive Committee and Program Coordinator, Jim Habiger, that the Space Technology Center produce a set of overlay maps for each of the eight counties involved in the program. Map overlays will show land-use geological structure, oil and gas areas, saturated thickness of cenozoic deposits and ground water availability.

2.2 Methods:

Development of the land use overlay and relating overlays were compiled by ERTS-1 imagery and existing U.S.G.S. maps, respectively.

The land-use or resource classification to be employed on the Four Rivers project is an adaptation of the U.S.G.S. Geological Survey Circular 671, "A Land-Use Classification System for Use With Remote Sensor Data".

After thoroughly discussing what could be mapped (with confidence) using this system, the following categories were decided upon:

01. Urban and build-up (any detail within this category will be mapped separately).
02. Agricultural land
 - 02.01 Cropland and pasture land
 - 02.01.01 Cropland
 - 02.01.01.01 Irrigated
 - 02.01.01.02 Dry
 - 02.01.02 Pastureland
 - 02.01.03 Feeding Operations
 - 02.01.04 Other
03. Rangeland
04. Forest land
05. Water including natural drainage, irrigation canals, water bodies (reservoirs, ponds, municipal sites, etc.)
06. Wetlands
07. Barrenland

Using a Saltzman Enlargement Projector the ERTS-1 imagery was scaled to 1:250,000 and mapped. Photo analysis of the imagery gave the delineation of boundaries between the seven classifications. ERTS-1 images of different dates were used to assure the most possible accuracy. These included dates of 26 October 1972, 17 March 1973, and 6 April 1973. All four bands were used to verify boundary delineations.

After boundaries were drawn, each individual county was scaled to the base map, 1:126,720. Supplemental data, provided by the RC&D district, are transferred to overlays and scaled to the base map prior to final drafting.

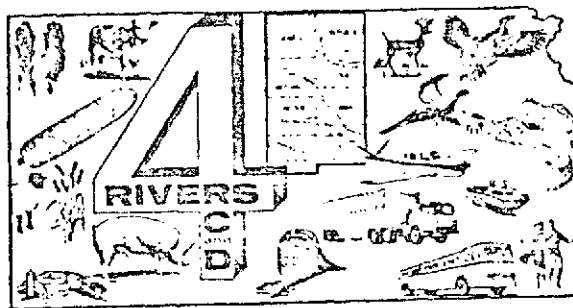
Results (present status):

At the time of this report, compilation of all eight counties has been done. Revision, using the recent ERTS-1 imagery of 6 April 1973 will be done on six counties. Therefore, two counties, Ellsworth and Lincoln, are in the final drafting process. The other overlays including the land-use map are also in final drafting.

A deadline date for all overlays to the eight counties will be October 22, 1973. At this time the Space Technology Center will present the committees in each county with their maps. Following completion of these county overlays, a regional compilation of the eight counties will be constructed at a scale of 1:250,000.

FOUR RIVERS RESOURCE CONSERVATION AND DEVELOPMENT PROJECT

BO 188 / MINNEAPOLIS, KANSAS 67467 / 913-392-3203



MARK L. McHENRY
Chairman

Route 3
Minneapolis, Kansas 67467
Ttawwa County
Phone 913-392-2634

JAMES P. McKEOWN
Chairman
Simpson, Kansas 67478
Mitchell County
Phone 913-593-4845

LOUIE HEDSTROM
Treasurer
324 East Ninth
Concordia, Kansas 66901
Cloud County
Phone 913-243-2247

ROBERT E. JOHNSON
Secretary
Route 1
Bushton, Kansas 67427
Ellsworth County
Phone 913-683-5368

CARL WESTIN
Mankato, Kansas 66956
Jewell County
Phone 913-378-3946

WILSON MARSHALL
Route 2
Barnard, Kansas 67418
Lincoln County
Phone 913-524-4897

EDWARD PACHTA
Belleville, Kansas 66935
Republic County
Phone 913-729-3402

BYRON A. JOHNSON
Route 2, Box 72
Salina, Kansas 67401
Saline County
Phone 913-823-8388

January 24, 1974

APPLICATIONS FILE NO. 2230-15

Mr. Robert L. Walters
Manager, Research Facilities
The University of Kansas Space
Technology Laboratories
2291 Irving Hill Dr. - Campus West
Lawrence, Kansas 66044

Dear Bob:

The Four Rivers Resource Conservation and Development project has been greatly benefited by the fine work your staff did in interpreting the ERTS imagery for land uses. The material is being used by resource committees for many purposes and is considered among the most useful material.

One of the major problem areas defined by the Land, Water, Agriculture and Forestry Utilization Committee is the flood plains of the 4 Rivers and their major tributaries. The problems include human suffering, economical liabilities and improper land use.

To achieve sufficient resource data upon which sound land use plan can be implemented, more specific information is necessary. Would you have the capability to provide the information needed?

I am asking the project coordinator to work with you in regard to this question.

I am hopeful you will be able to provide these needs as successfully as the land use maps.

Sincerely,

Mark L. McHenry

Mark L. McHenry

Cooperative

EXTENSION SERVICE
of Kansas State University

Division of Extension
Extension Forestry
2610 Claflin Road
MANHATTAN, KANSAS 66502
Phone: 913 532-5752

"Taking the UNIVERSITY to the PEOPLE"

January 7, 1974

Mr. B. G. Barr, Director
Space Technology Center
2385 Irving Hill Rd.-Campus West
Lawrence, Kansas 66044

Dear Mr. Barr:

I am sorry I did not get this letter written as soon as hoped, but several unexpected items came up last week.

Our Department of State and Extension Forestry is the state forestry agency responsible for promoting proper management and utilization of Kansas' forest resources. Good reliable forest resource data is a most valuable tool in our efforts.

We conducted a detailed statewide forest inventory in 1964 and 1965. This inventory gave us comprehensive forest resource data on the basis of individual county or county blocks. Since the only previous forest inventory was done in 1936, we were unable to make any reasonable trend projections on the forest resource. We strongly feel that another forest inventory within the next two or three years is needed so that we can begin building a basis for predicting trends in our forest resource data.

We are continually receiving requests for forest resource data from various agencies involved in comprehensive planning efforts. Resource Conservation and Development (RC&D) Projects and PL 566 Small Watershed Districts are examples of planning efforts where we are asked to supply forest resource data.

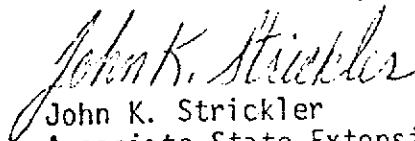
Before any wood-using industry considers relocation or expansion, it must have basic forest resource data. An out-of-state company is considering location in the Four Rivers RC&D area, and one of their primary concerns is the availability of cottonwood timber within a reasonable proximity to their proposed mill.

January 7, 1974

We would certainly be interested in any detailed forest resource data that could be obtained through the capabilities of your Space Technology Center. Our needs for forest resource data would include acreage figures by topographic, stand size, and stocking classifications. For practical application, these acreages need to be by county or county blocks.

If there is any way we can work with the Space Technology Center within reasonable limits of time and personnel, we would be most happy to do so. Thank you for your interest.

Very truly yours,



John K. Strickler
Associate State Extension Forester

JKS/plp

APPLICATIONS PROJECT SUMMARY

Appendix (g)

Project Title: Develop a Land Use Map Using Remote Sensing in the Kansas River Floodplain,
Wyandotte County, Kansas

Participating Agencies:

Key Personnel:

Agency:

Thomas Palmerlee
Program Development Specialist
City Planning Commission
City of Kansas City, Kansas

CRINC:

Jerry Coiner
Don Williams
Remote Sensing Laboratory
Robert Walters, Coordinator, STC
B.G. Barr, Director, STC

Tentative Completion Date: November 30, 1973 **Starting Date:** April, 1973

1.0 Introduction:

The City Planning Commission of Kansas City, Kansas has a requirement that a land use map be provided by April 15, 1973 for the Armourdale District and nearby floodplain. This area is a mixed land use area composed of older residential dwellings and industrial areas. In order for the Board of City Commissioners to make an intelligent decision regarding development (both short and long range) a data set describing the present land uses and their quality is required.

2.0 Statement of Work

2.1 Objectives:

1. To obtain a data set from aerial sensors to support short and long range development plans for the Armourdale District of Kansas City, Kansas
2. To specify the types of remotely acquired data that would provide the optimum inputs to a land use data system.
3. To develop image interpretation methods that could be directly used by planning personnel without the assistance of image analysts.
- and 4. To further evaluate the role of various types of remotely sensed data in acquiring new types of data elements about the urban landscape.

2.2 Approach:

Straightforward approach of human interpretation of various scales of imagery. On January 20, 1973 large scale color aerial photography was flown of the Armourdale District using the KU Remote Sensing aircraft. This material is now being interpreted by Mr. Palmerlee and his associates at the city planning department with aid and training being provided by Mr. Coiner and Williams of CRINC, RSL. At present the data elements to be extracted from the imagery have been determined and a preliminary interpretation by City Planning personnel is underway.

2.3 Anticipated Results:

Short range: Land use maps which Board of Commissioners can use in decision making process on Armourdale District.

Long range: If data elements can be successfully extracted from the imagery and are found useful to the planning and political structure within the city, then a more extensive project is envisioned to support a long range planning effort for the entire area of Wyandotte County, which includes Kansas City, Kansas.

2.4 Funding:

The Center is providing training for Planning Department personnel and the aerial photos required. The agency is supplying the ground truth and personnel to work with interpreters to develop the land use map.

Project Title: The Use of Remote Sensing to Evaluate Reclamation of Land Strip-Mined for Coal

Participating Agencies: Kansas Geological Survey
Ozarks Regional Commission

Key Personnel:

Agency:

Ronald G. Hardy, Chief
Mineral Resources Section
Kansas Geological Survey
Mary Alice Soule, Research Assistant
Mineral Resources Section
Kansas Geological Survey

CRINC:

Dr. Louis Dellwig
Remote Sensing Laboratory
Space Technology Center

1.0 Introduction:

This applications project was initiated to determine the feasibility of using remote sensing data to evaluate the progress and success of reclamation of land strip-mined for coal in Southeast Kansas. Both voluntary reclamation projects and reclamation mandated by the 1969 Mined-Land Conservation and Reclamation Act are being studied to identify factors relating to the success of reclamation.

2.0 Statement of Work

2.1 Objectives:

Multiband aerial photographs taken at three times during the period of study are being compared and evaluated to determine which film/filter combinations are best and at what time of year the most useful information can be derived from the imagery. Any differences between voluntary and mandatory reclamation projects will be identified to provide information for people involved in reclamation.

It is anticipated that this project will demonstrate to the coal companies and the Kansas Department of Labor, the state regulatory agency, the efficacy of remote sensing as a means to evaluate the success of reclamation.

2.2 Approach:

Ground truth data has been collected in conjunction with the multiband photo flights. These include observation of the condition of vegetation on reclaimed land and soil sampling to determine what edaphic factors influence variations in plant vigor detected on false-color infrared imagery.

A number of secondary areas to be investigated have been suggested by evaluation of the imagery. Among these are the quality of water in the strip lakes after mining, the chemical nature of the overburden as it relates to the success of vegetation of the leveled spoils, and mining methods which influence the leveling and reclamation processes.

2.3 Results to Date:

One striking difference between voluntary and mandatory reclamation has been detected on the imagery. On mandatory reclamation sites the vigor of vegetation is relatively uniform except for irregular bare areas, "hot spots" where soil pH is too acid

to permit plant growth. On voluntary reclamation sites, bare leveled ground appears uniform in color, but fields with a vegetative cover show light and dark color banding. This banding seems caused by variation in vigor of the vegetative cover because it appears as pink and red bands on false-color infrared imagery. The red bands are fill areas, valleys between the spoils piles that have been filled with organic material and weathered debris from the peaks as they were leveled off and graded, while pink bands correspond to peaks. Surface soil samples were taken but showed no striking differences in pH or nutrient components to indicate locations of fill (valley) areas or leveled peaks.

The color of water in strip lakes and access roads in abandoned mines varies from yellow to brown to blue-green. Preliminary pH values for four such water bodies indicate they are all highly acid (3.5-4.5 pH range). This means that there is a potential acid mine drainage problem in some areas, although other strip lakes in Southeast Kansas have pH values near 7.0. The possibility of an acid problem indicates the necessity for isolating and burying acid overburden so it does not contaminate surface water.

2.4 Anticipated Results

The results of this will be to demonstrate the use of remote sensing as a tool to aid coal companies and regulatory agencies in evaluating the success of reclamation. The best film/filter combination and season for obtaining imagery will be determined so that the cost of obtaining imagery can be kept at a level consistent with corporate and state agency budgets.

A second set of soil samples which were obtained from the sub-surface levels are being analyzed to determine what variations can be related to banding on voluntary reclamation sites. The cores from the second samples were observed to determine differences in root penetration which might indicate compaction. Because these spoils had been untouched for twenty-five years before leveling both compaction and leaching may play important roles in influencing plant vigor.

2.5 Funding

Funds for flights were provided by CRINC applications project 2230-5 (NASA Grant NGL 17-004-024). Salary and travel expenses were provided by a grant from Ozarks Regional Commission and supporting services were contributed by the Kansas Geological Survey.

APPLICATIONS PROJECT SUMMARY

Appendix (i)

Project Title: Evaluation of Soil Moisture Conditions Related to Release Outflow from Rathbun Dam

Participating Agencies: U. S. Army Corps of Engineers

Key Personnel:

Agency:

Mr. Darald Saratt

816/374-5652

Mr. Jack Nelson

816/374-5053

Mr. Claren Kontz

816/374-3651

U. S. Army Corps of Engineers

Kansas City, Missouri

CRINC:

B. G. Barr, Project Director

Robert Walters, Coordinator

Robert Eastmond, Program Scientist

Ted Talmon, Interpreter

Tentative Completion Date: 1 August 1973

Starting Date: 20 June 1973

1.0 Introduction:

The Rathbun Reservoir just north of Centerville, Iowa (Figure 1) is a primary flood control structure on the Chariton River. The Chariton River runs south from Rathbun eventually joining the Missouri River near Brunswick, Missouri. Much of the river from the Dam to near Worthington, Missouri has been channelized with the exception of an 8 mile stretch known as the Missouri Narrows. Outflow releases from Rathbun reportedly created moisture stress conditions along areas of the Chariton River flood plain from Rathbun to Livonia, Mo. in the spring of 1973.

2.0 Statement of Work

2.1 Objectives:

The project was designed to utilize remote sensing to evaluate soil moisture conditions and vegetation effects in the Chariton River flood plain below Rathbun Dam. An attempt was made to correlate outflow releases from the Dam with soil moisture conditions on the flood plain. Results from the present, relatively moist conditions will be compared at a future date with drier soil conditions.

2.2 Approach:

Determining soil moisture and vegetation stress requires both photo reading (the process of simple recognition of objects seen in the photograph) and photo interpretation (the evaluation of several elements of the pattern

present in the photograph). Relatively little time is required to do the photo reading. Photo interpretation requires much more time. Supplementary information may significantly reduce the time required in this phase of the analysis. In the present study, a field check will be utilized to help establish the critical recognition categories for the photo interpretation. Color and black and white infrared aerial photography will be used.

2.3 Anticipated Results:

This project will attempt to determine excessive moisture in the flood plain below the Dam and the extent of any vegetation stress. Additional flights at a later date will determine the effect of outflow change. This study provides an excellent experimental project using remote sensing in coordinating outflow releases from a reservoir as related to farming practices in the area.

2.4 Funding:

Funding for the photographic mission and ground checks will be provided by the Corps of Engineers. Interpretation will be accomplished by the Space Center staff.

Project Title: Douglas County Applications of Remote Sensing - DCARS

Participating Agencies:

Key Personnel:

Agency: All county officials
Douglas County Kansas
See seminar report

CRINC: John Barr, Research Assistant
Stan Morain, Prof. of Geography
Robert Walters, Coordinator
B.G. Barr, Project Director

Tentative Completion Date: June 30, 1973
Continuing Project

Starting Date: May 15, 1972

1.0 Introduction:

The purpose of the DCARS project was to obtain a multiband/multidate photographic data base for Douglas County, Kansas. The data base is available to any interested user for the application of remote sensing information to his particular needs. In conjunction with this primary goal is a project to develop a set of land use and associated factor maps for Douglas County.

2.0 Statement of Work

2.1 Objectives:

The primary objective of this project is to provide a current source of multiband photographic information that can be applied to any public project requiring remote sensing data in Douglas County. Proximity to KU, character of terrain and expected land use changes dictated selection of this area.

2.2 Approach:

Green, red and near-infrared black and white photography and color infrared photography have been taken on a monthly schedule, weather permitting. A seminar was held in June of 1972 to inform individuals of the availability of the imagery. The secondary project associated with land use and factor mapping of the county has converged into a separate project in cooperation with the county planners and is reported on in another section. Many other uses have been made of the data base, some of which are listed below. 1. Assessment of agricultural land capability and the conjunctive farming practices. 2. Mapping and correlative interpretations with radar agricultural studies. 3. Large scale stereoscopic interpretation and mapping of vegetation. 4. Interpretation of surface materials for a heat island study of Lawrence, Kansas. 5. Updating of land use information for publication of the Douglas County soil survey by the Soil Conservation Survey. 6. Interpretation of road surface materials in Douglas County. 7. Clinton Reservoir (a) Land use planning by the Douglas County planner (b) Geologic study for the Corps of Engineers of the dam site and surrounding area.

2.3 Anticipated Results:

The Use of the data base has been substantial. Many current projects are in progress that are utilizing the DCARS data base. It is anticipated that upon completion of the Clinton Reservoir Land Use Planning Project, the same process of interpretation will be performed for the remainder of Douglas County.

2.4 Funding:

Applications Grant



CITY COMMISSION
MAYOR
JOHN H. EMICK
COMMISSIONERS
CHARLES FISHER
NANCY HAMBLETON
J. R. PULLIAM
JACK ROSE

City of Lawrence KANSAS

BUFORD H. WATSON, JR., CITY MANAGER

CITY OFFICES 910 MASSACHUSETTS ST.
BOX 708 66044 913 643-4600

January 28, 1974

Mr. B.G. Barr
Director of Space Technology Center
University of Kansas
Lawrence, Kansas 66044

Subject: Aerial Photograph of the Southwest Quarter of Section
4-13-19, Douglas County, Kansas

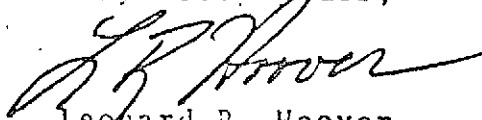
Dear Sir:

I wish to thank you and your people for the enlargement prepared
of the subject area.

The City is involved with a proposed project to cover the old
landfill area with topsoil suitable for seeding and preparing the
area for a future park. Your photograph was taken after the City
had abandoned the site and all stripping and covering had ceased.
A more accurate picture of the areas to be covered was secured
from the prints furnished this office.

Your cooperation was greatly appreciated.

Very truly yours,


Leonard B. Hoover
City Engineer

LRH:saw



CRINC LABORATORIES

Chemical Engineering Low Temperature Laboratory

Remote Sensing Laboratory

Flight Research Laboratory

Chemical Engineering Heat Transfer Laboratory

Nuclear Engineering Laboratory

Environmental Health Engineering Laboratory

Information Processing Laboratory

Water Resources Institute

Technical Transfer Laboratory

Air Pollution Laboratory

Satellite Applications Laboratory